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CHEST LESIONS OFTEN CONFUSED ROENTGENOGRAPHICALLY WITH PRIMARY CANCER OF THE LUNG*

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THIS discussion is not intended as an apology for the inaccuracy of the roentgen examination. With the ever increasing complexity of differential diagnosis and the increased vigilance of the internist in a more complete study of the individual case through mass surveys and routine roentgen examinations, the problems of chest diagnosis are becoming more intricate. This is true even with the greater help we are now receiving from bronchoscopic examinations, from intrabronchial biopsies, and even with the study of bronchial secretions and sputa which has recently been popularized. As in the case of gastrointestinal cancer, we must increase our efforts toward early diagnosis if we are to detect malignant lesions of the lung and bronchus in time for the surgeon to have his procedures curative. The fact is that at the present time every relatively atypical lesion, both as to roentgen appearance and clinical course, must be considered malignant until proved otherwise. There was a time when the diagnosis of carcinoma of the lung was relatively rare. Now it is a necessary differential consideration for almost every chest lesion seen in an individual over forty years of age.

We must emphasize an oft repeated axiom, that a shadow of any character seen on the roentgenogram is merely a record of gross pathology as reflected in the shadow contours, position and density. Knowing that carcinoma can, at some time or other, mimic almost every other chest condition known, the roentgenologist must use caution in attempting to make a dogmatic diagnosis. The roentgenogram, however, still remains the only way in which one can make the early diagnosis of a lesion which is peripheral and beyond the reach of the bronchoscopic observer, and beyond the scope of other laboratory examinations. Neither bronchoscopic examinations, nor the study of the bronchial secretions and sputum tells the entire story, even though they all have served to greatly increase the accuracy of chest diagnosis. We have not yet arrived at the point where we can hope that every atypical lesion which the bronchoscopist or the pathologist studies in this manner can be diagnosed unequivocally.

Thus the surgeon will have to do an exploratory operation in a number of cases when the roentgenogram shows findings highly suggestive of a neoplasm and when a study of the bronchial secretions,

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sputum or the bronchoscopic examination is indeterminate. The more chest lesions one sees, and the more thoroughly one studies each case, a greater number will there be of cases where a confusion may exist. Every diagnostic procedure has its limitations, and we will, in the case presentations and illustrations which follow, attempt to show where we were in doubt in a number of cases and where we were wrong in others.

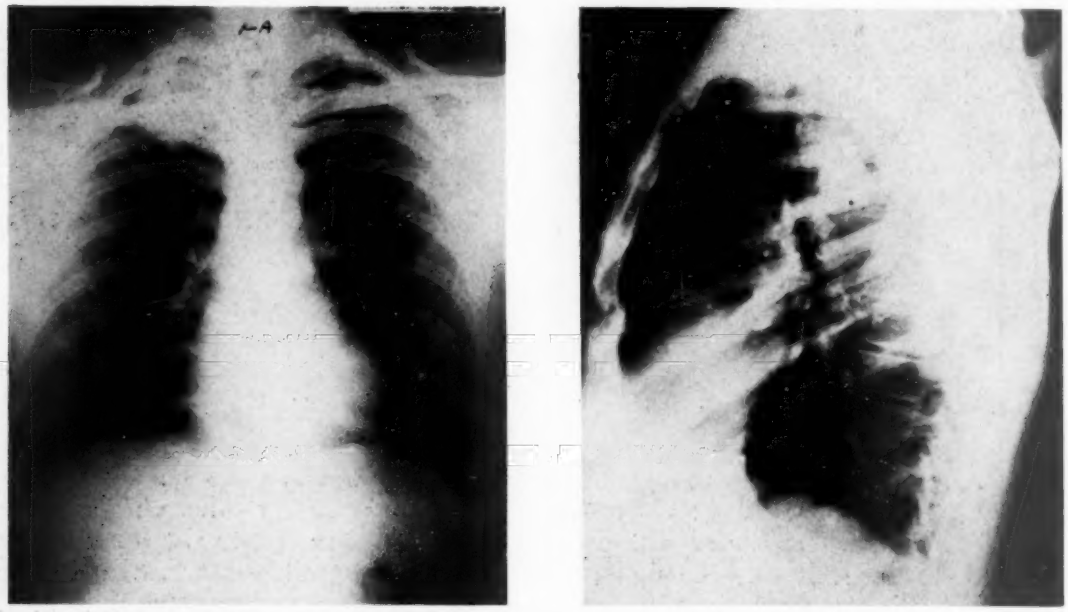


Fig. 1. Case 1. M. N. A lesion simulating a ganglioneuroma was discovered during a routine chest survey on this male, aged forty-five. The patient was asymptomatic, except for a chronic, non-productive cough. The roentgen impression was neurofibroma, but other tumors, both benign and malignant, could not be ruled out. Because of this, a thoracotomy was performed which revealed a soft, ovoid mass. Its cut surface was composed of lipoid tissue. The histopathologic diagnosis was lipoma of the mediastinum—retropleural, superior and posterior.

In the case of suspected carcinoma of the lung, there is no time to lose. It might be asked why one cannot wait to watch the evolution of a lesion long enough to let the characteristics of rapidity of growth and the eventual effect on the dynamics of the thorax decide the case. The unfortunate fact is that most lesions do not grow fast enough to prove their malignant character, and if one waits for this feature, they will in the meantime do infinite harm to the patient through distant metastases.

We recall one case of a young physician in whom a shadow was found at the periphery of one of the lung bases on a routine mass survey chest film. The patient lost no time in submitting to a lobectomy. The lesion was extremely small. It had not increased sufficiently in size in two or three weeks to make the diagnosis particularly definite. The patient survived the operation and the convalescence was quite uneventful. There was never any local recurrence, nor was there any recurrence in the regional nodes of the mediastinum, yet nine months later the patient died of a single large metastatic focus in the brain.

Once the question of a neoplasm has been raised, one must never temporize. Every cavity in the lung, with or without a fluid level, must be considered as probably associated with tumor until proved otherwise. Likewise, every apparently "solid" shadow deserves special attention, particularly in a patient over forty years of age.

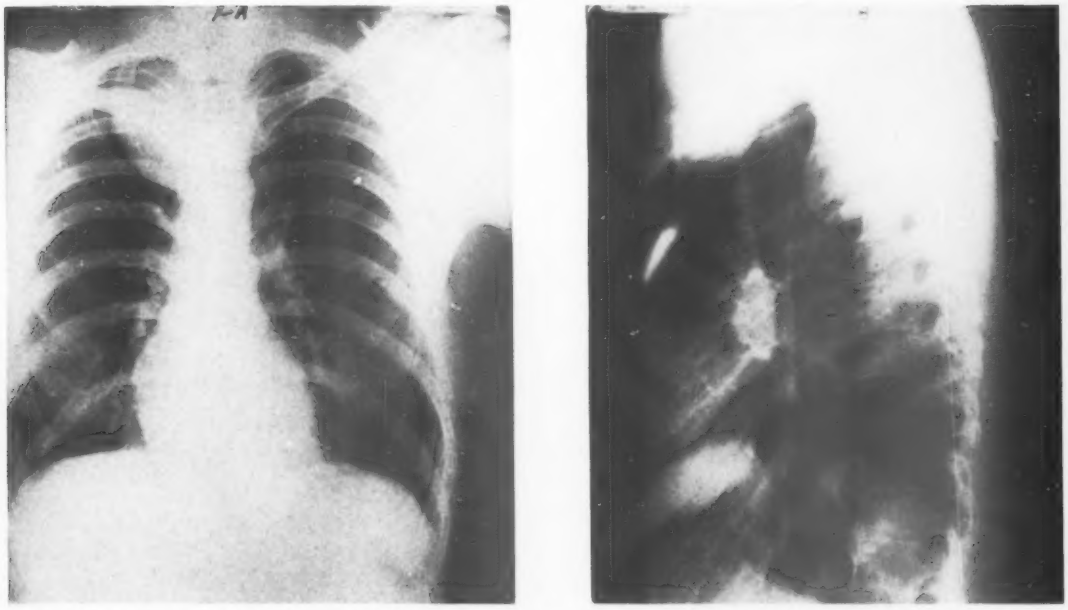


Fig. 2. Case 2. E. C. This patient, aged thirty-two, was rejected for service in the Navy because of a mass in the right lung field. At operation a mediastinal mass was removed from the posterior mediastinum. It was a firm, smooth tumor attached to the spinal column. The histopathologic diagnosis was fibroneuroma.

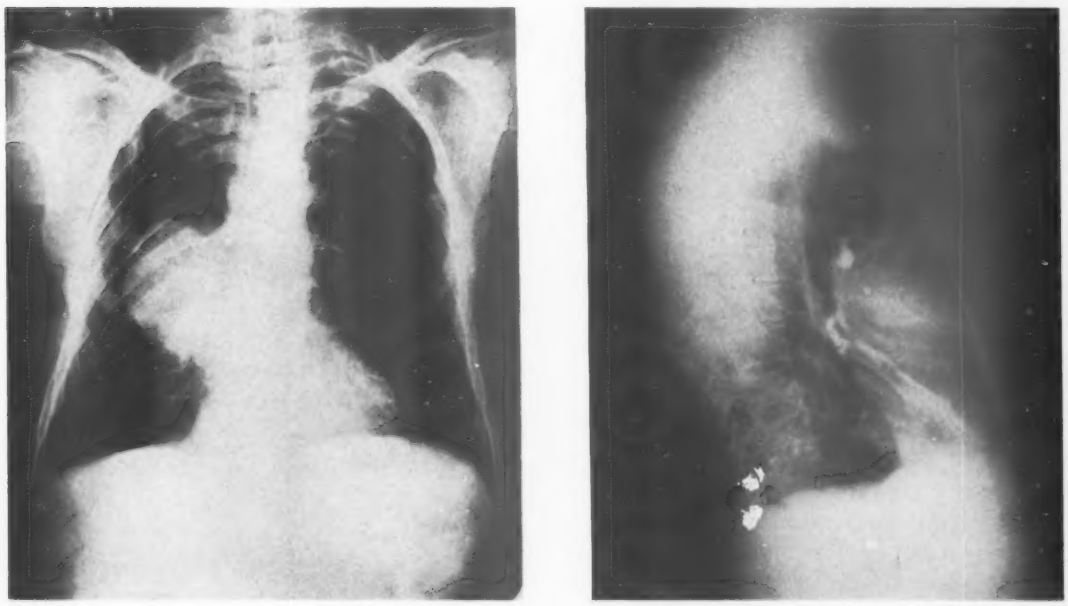


Fig. 3. Case 3. M. S. This white male, aged sixty-nine, had a history of left chest pain, hemoptysis, loss of weight and progressive weakness. The chest film shows a round, well defined opacity in the right upper lobe anteriorly. Bronchoscopy revealed a shift of the right main bronchus medially and posteriorly. Aspirated secretions revealed no cancer cells. The impression was that of cancer of the lung or lung metastasis. At operation a mass the size of an orange was removed which was firm and contained caseous material. Gross surgical diagnosis was tuberculoma. Histopathological examination revealed bronchogenic carcinoma.

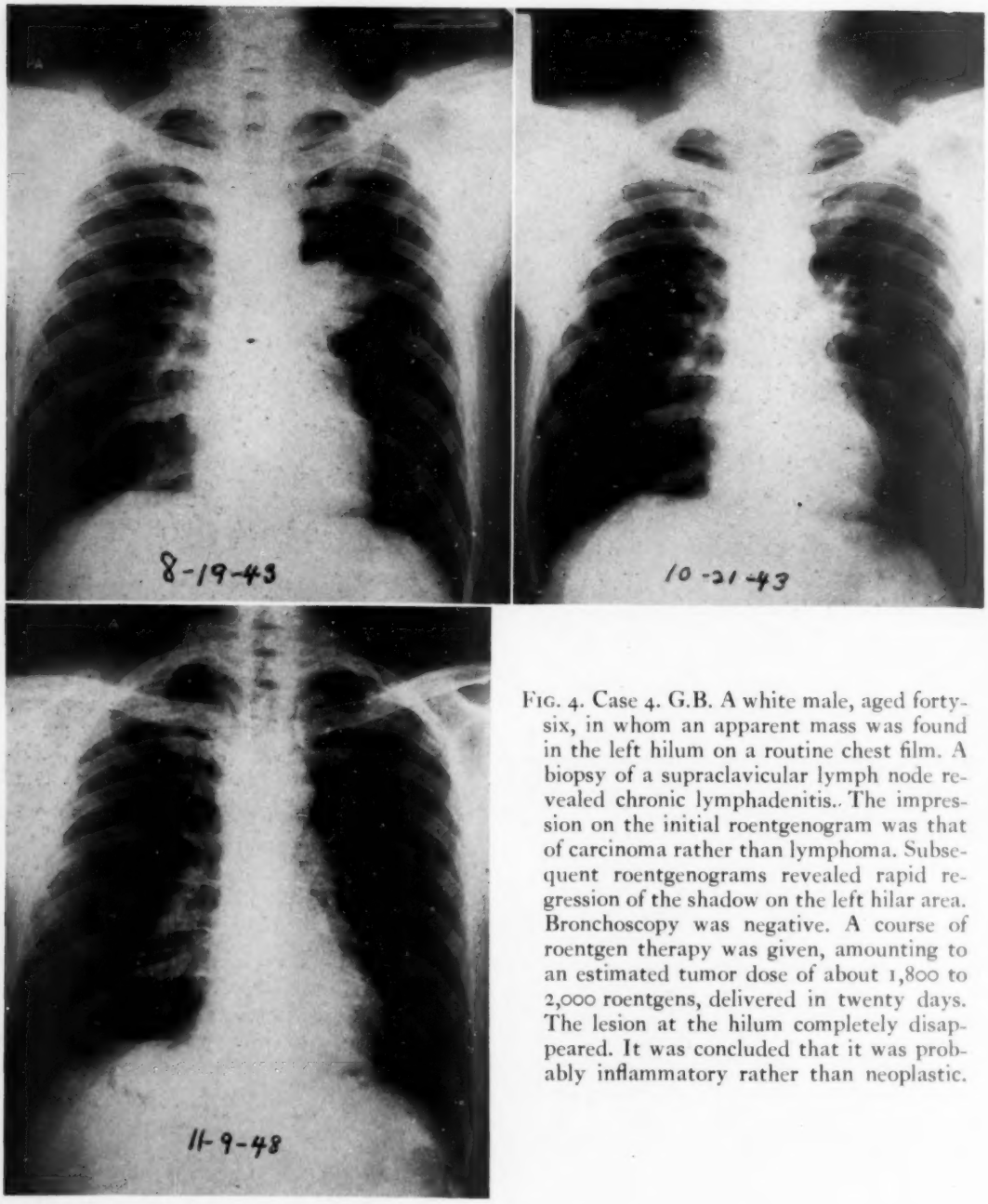


FIG. 4. Case 4. G.B. A white male, aged forty-six, in whom an apparent mass was found in the left hilum on a routine chest film. A biopsy of a supraclavicular lymph node revealed chronic lymphadenitis. The impression on the initial roentgenogram was that of carcinoma rather than lymphoma. Subsequent roentgenograms revealed rapid regression of the shadow on the left hilar area. Bronchoscopy was negative. A course of roentgen therapy was given, amounting to an estimated tumor dose of about 1,800 to 2,000 roentgens, delivered in twenty days. The lesion at the hilum completely disappeared. It was concluded that it was probably inflammatory rather than neoplastic.

INFLAMMATORY LESIONS

There are various inflammatory lesions which are continually being confused with a possible malignant process. The reason is that more are being picked up by mass surveys that are relatively asymptomatic and when the roentgenologist sees a "solid shadow" lesion where symptoms are few, or absent entirely, he should not temporize. By the same token, because some of these lesions are being explored and removed by lobectomy or pneumonectomy, we are seeing more unusual inflammatory lesions of relatively low grade virulence in their acute or subacute stages. Previously these processes were followed until they became organized, with a fibrotic stage predominating, whereas we now see them

in an earlier stage. An interesting finding in this regard is the so-called cholesterol pneumonia recently described by Robbins and Sniffin[9] which in its early stage shows a high content of doubly refractive cholesterol crystals. Later, in its end stage, it looks like any healed interstitial pneumonitis. It resembles lipoid pneumonia in this respect. The cholesterol content in the early stage has been found to be as high as twenty times the normal.

Lipoid pneumonia may give a solid shadow which looks like a mass lesion and which, to the surgeon on exploration, will suggest cancer only to have the diagnosis reversed when the histopathologic structure is studied.

Nonspecific granulomas, for want of a better term, have been described where the only finding is that of a solid shadow which eventually disappears and is never satisfactorily explained. On the basis of its course, however, it must have been an inflammatory process. Some of these lesions have disappeared under roentgen therapy only, but the dosage has hardly been great enough to be curative if the lesions were malignant.

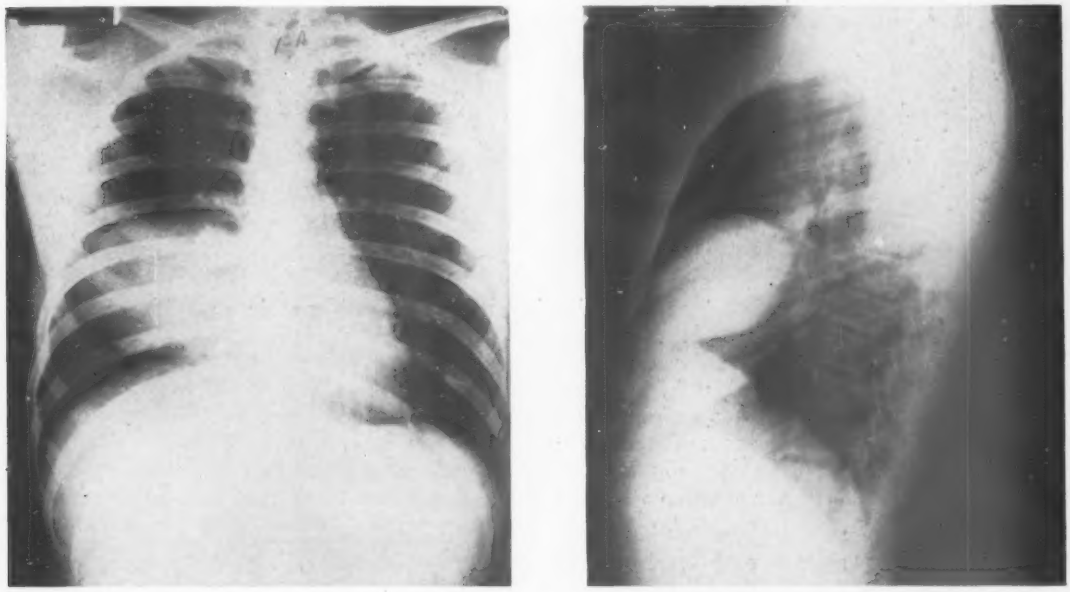


FIG. 5. Case 5. M. S. This white male, aged nineteen, was admitted with a history of cough, fatigue and recurrent hemoptysis. The initial chest roentgenogram, done elsewhere, revealed a sharply circumscribed, round shadow in the right middle lobe, thought to be fluid or an infected cyst. A smooth globular swelling was noted in the right scrotum which, at orchidectomy, proved to be a teratoma of the right testicle. Following the latter procedure, the patient complained of pain in the left chest. Exploratory thoracotomy revealed a tumor mass in the right middle lobe. Frozen section revealed adenocarcinoma, suggestive of teratomatous type. Later, a second thoracotomy was performed, followed by roentgen therapy. He died the seventy-fifth day after admission. The autopsy revealed a lung metatasis on the right and metastatic nodules in the left pleura. The final diagnosis was carcinoma of the testes with metastasis to the lung.

These five cases all show similar sharply demarcated mass lesions in which carcinoma merited a place in the differential diagnosis. The bronchial secretions and bronchoscopy were negative for definite evidence of tumor in the case of the one (Case 3) which *was* primary carcinoma.

Nonspecific indurative pneumonitis accompanying bronchiectasis may also be most difficult to prove completely benign. We know that the same conditions will prevail accompanying a neoplasm as a result of the bronchostenosis. Therefore, one is often confronted with the problem of proving whether or not a neoplasm is present, even though the main pathologic finding is bronchiectasis with a surrounding

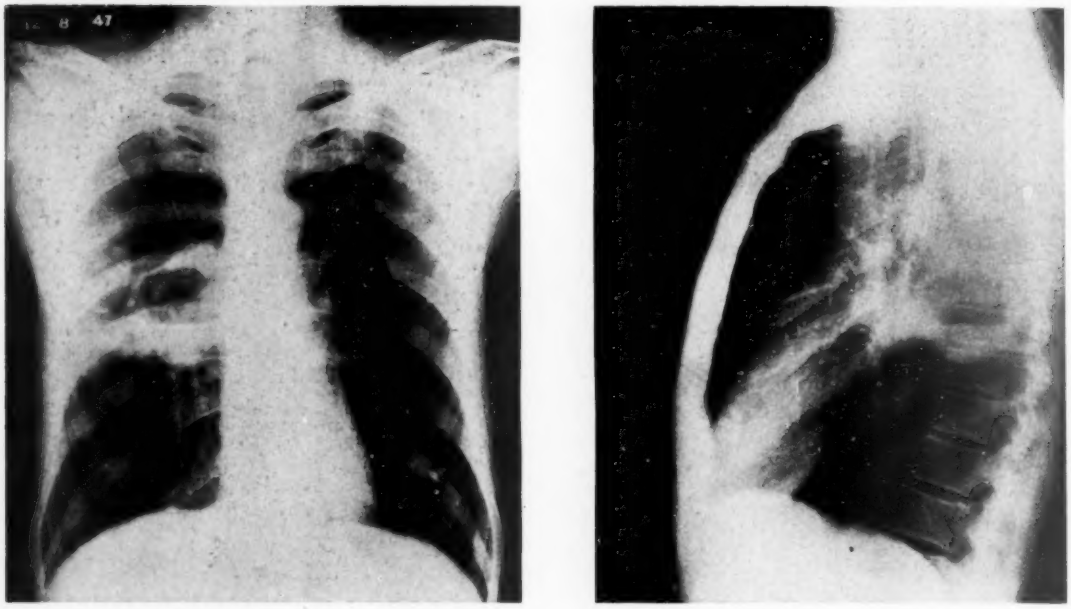


FIG. 6. Case 6. W. R. A chest film, done at another hospital, on this white male, aged fifty-eight, was interpreted as showing a lung abscess of the right lower lobe. Bronchoscopy revealed mucopus coming from the right lower lobe bronchus. A roentgenogram of the chest reveals a thick-walled cavity in the apex of the right lower lobe with a fluid level, and fairly regular walls.

Repeated bronchoscopy on two occasions revealed neoplastic cells in the aspirated secretions. At operation a pulmonary abscess in the apex of the right lower lobe was easily palpable. Proximal to this there was a mass 3 cm. in diameter at the right hilum. The patient went into severe shock and died on the operating table. The histopathologic examination showed excavating squamous cell carcinoma of the lung with abscess.

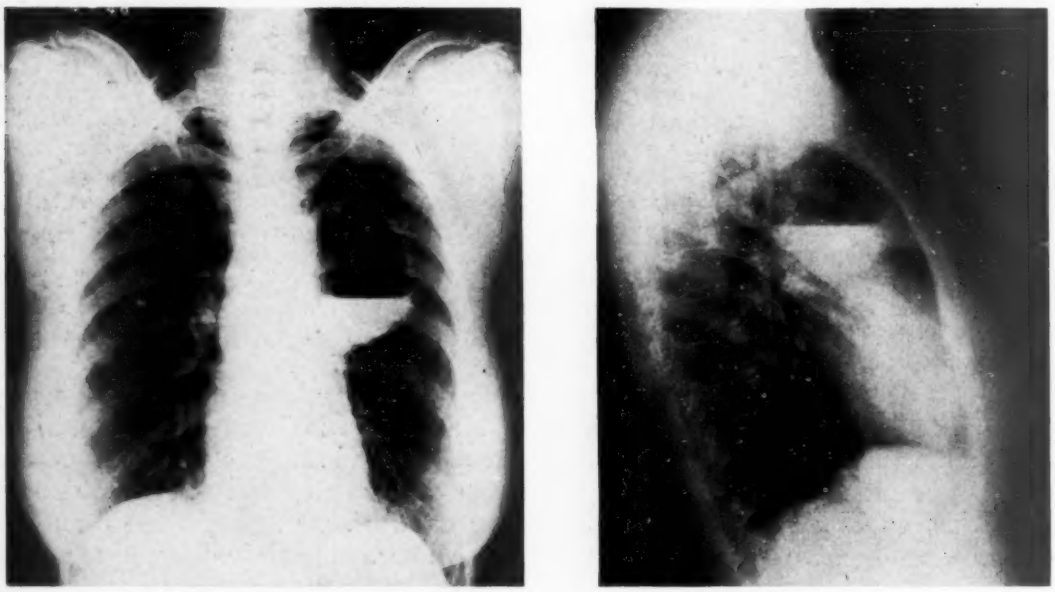


FIG. 7. Case 7. M. O. This white female, aged fifty-one, had noticed recurrent attacks of productive cough and pain in the left chest for several weeks. She was studied extensively and tuberculosis was ruled out. An earlier roentgen examination had suggested a lung cyst in the left upper lobe containing fluid. To rule out a neoplastic lesion, a left upper lobectomy was performed. Grossly, there was a large cyst of the left upper lobe. The histopathologic diagnosis was congenital lung cyst.

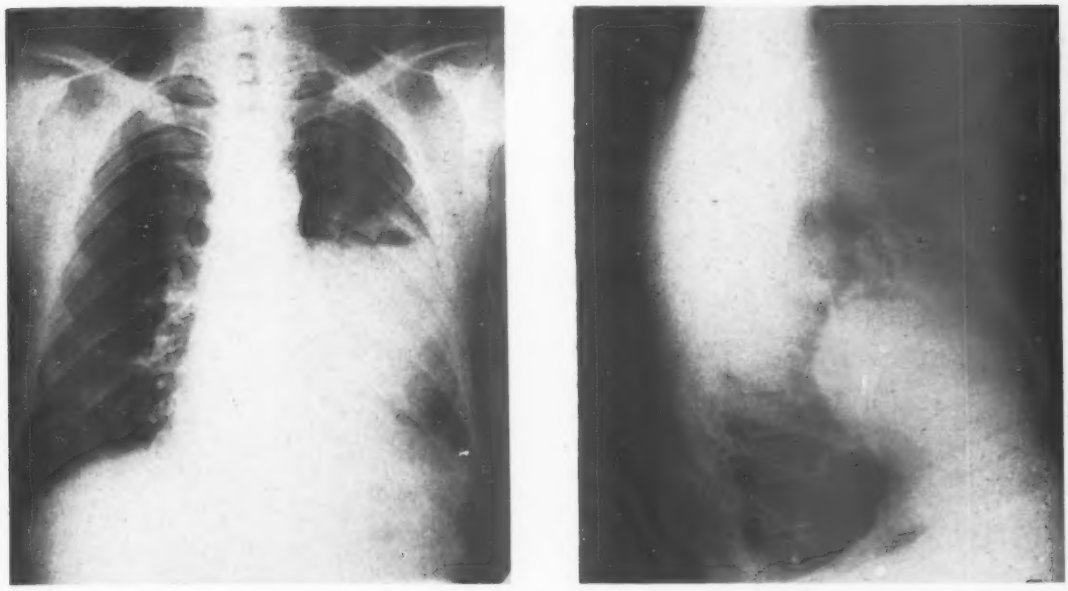


Fig. 8. Case 8. W. F. This white male, aged fifty-five, was thought to have a pulmonary abscess when admitted from another hospital. Bronchoscopy at Jefferson Hospital revealed a bloody, purulent secretion from the orifice of the left upper lobe and secretions were positive for neoplastic cells. A left pneumonectomy was performed. Grossly, the tumor occluded the left upper lobe bronchus. The histopathologic diagnosis was squamous cell carcinoma.

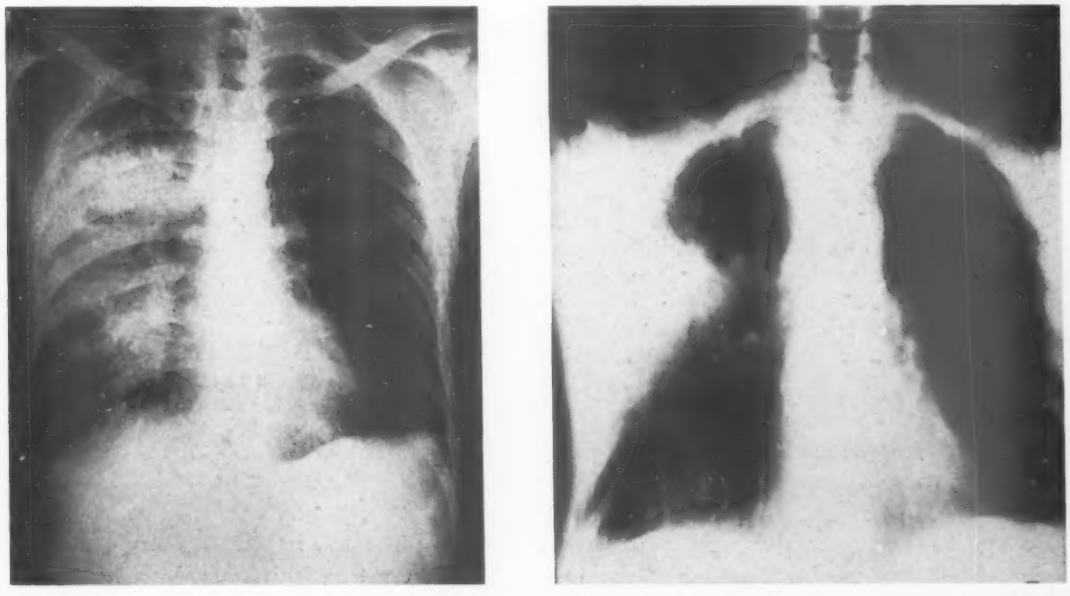


Fig. 9. Case 9. T. E. This white male, aged thirty-seven, had a severe cold with fever, cough and weight loss; treatment with chemotherapy was instituted, but the cough and weight loss continued. Bronchoscopy revealed a suppurative process in the right upper lobe. Planigraphic studies revealed two cavities in the left upper lobe. At operation the right middle and upper lobes were resected. The histopathologic examinations revealed chronic bronchiectasis.

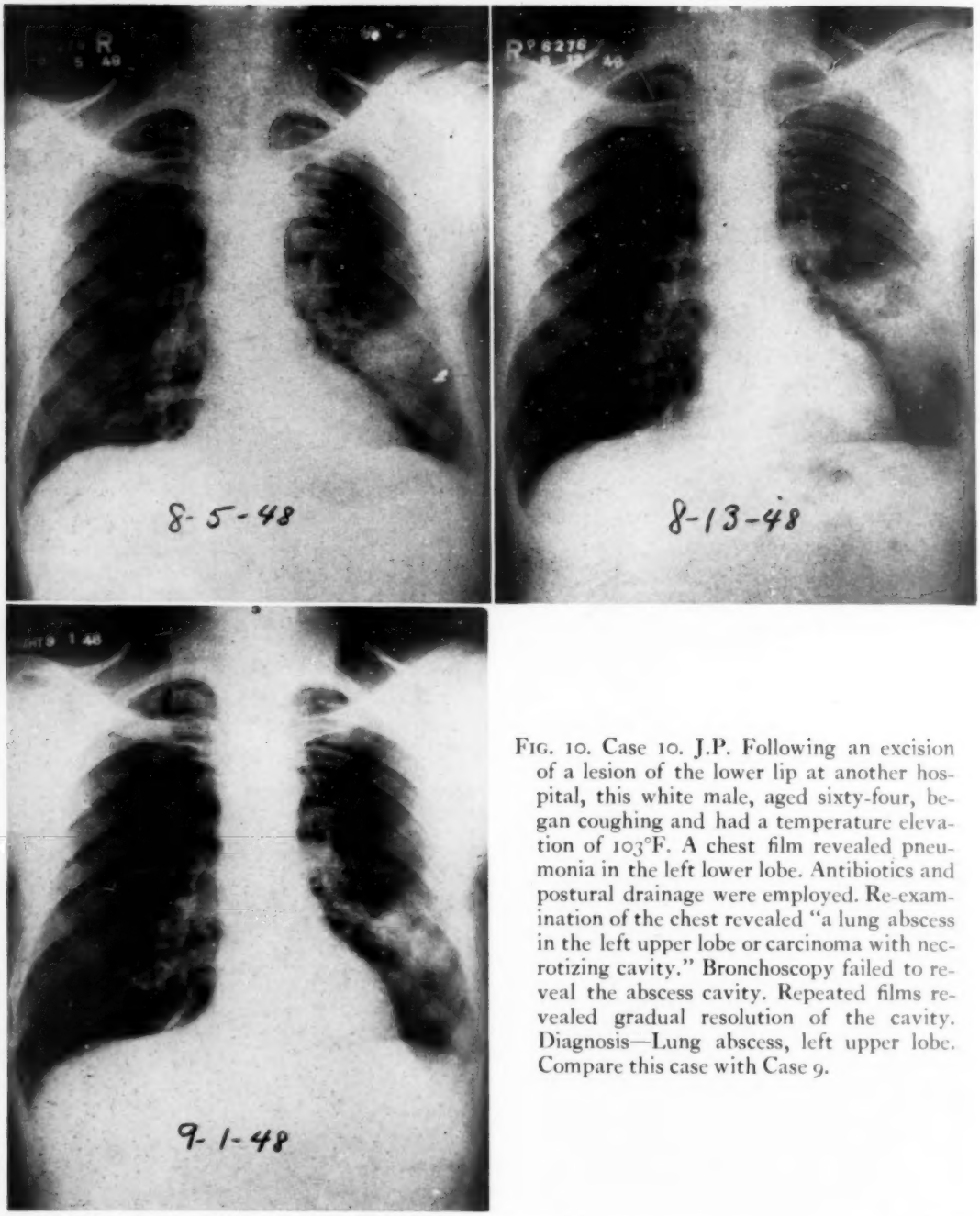


FIG. 10. Case 10. J.P. Following an excision of a lesion of the lower lip at another hospital, this white male, aged sixty-four, began coughing and had a temperature elevation of 103°F. A chest film revealed pneumonia in the left lower lobe. Antibiotics and postural drainage were employed. Re-examination of the chest revealed "a lung abscess in the left upper lobe or carcinoma with necrotizing cavity." Bronchoscopy failed to reveal the abscess cavity. Repeated films revealed gradual resolution of the cavity. Diagnosis—Lung abscess, left upper lobe. Compare this case with Case 9.

FIG. 12. Case 12. R. M. This white male, aged fifty-seven, had a history of recurrent cough with yellow sputum and occasional hemoptysis over a period of twenty years. The initial bronchogram revealed bilateral bronchiectasis. A second bronchogram revealed saccular bronchiectasis with cyst formation. A right lower lobectomy was performed. Gross pathologic and histopathologic examination revealed bronchiectasis with cyst formation. Note the similarity of this case to those with the same findings complicating malignant neoplasm.

Identical pictures are presented by these cases of bronchiectasis complicating neoplasm. Cells thought to be cancerous were found in one case.

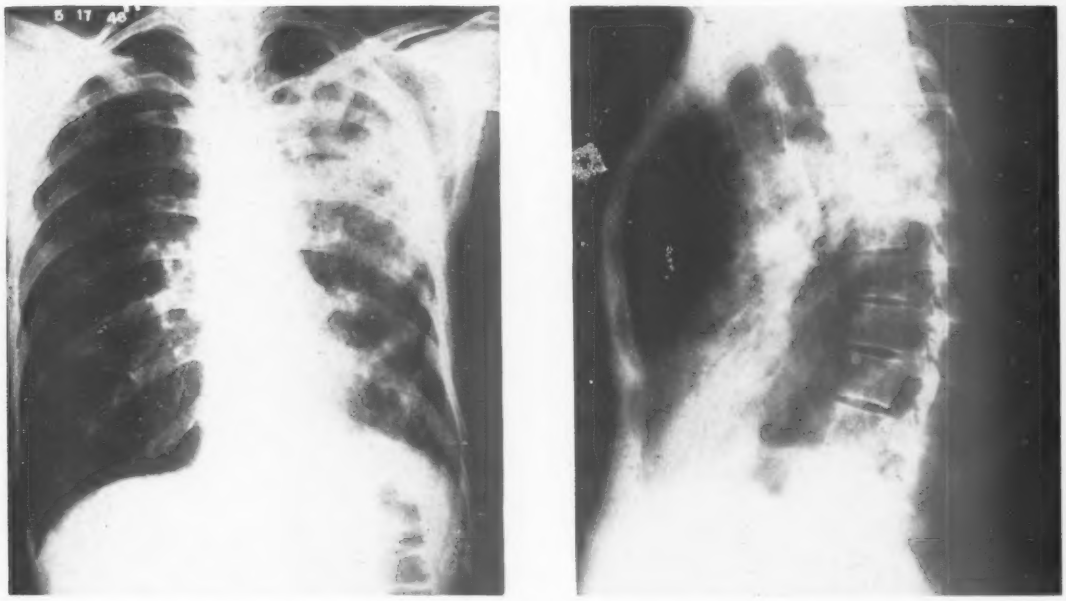


FIG. 11. Case 11. J. K. This white male, aged fifty-three, had a history of progressive loss of weight associated with cough which raised foul smelling pus. The chest roentgenogram suggested a lung abscess. Bronchoscopic examination revealed pus coming from the orifice of the left upper lobe bronchus. Roentgen examination revealed extensive mottling throughout the left lung field with a large translucent area with a fluid level in the left upper lobe. Secretions of the left upper lobe revealed cancer cells.

Additional history revealed that the patient had had some bad teeth extracted recently. In view of the multiple cavities in the left upper lobe in a man, aged fifty-three, the possibility of carcinoma was considered. On three occasions aspirated bronchial secretions revealed "cancer cells." A left pneumonectomy was performed. Grossly, the bronchus was free of tumors. Histopathologic examination revealed bronchiectasis.

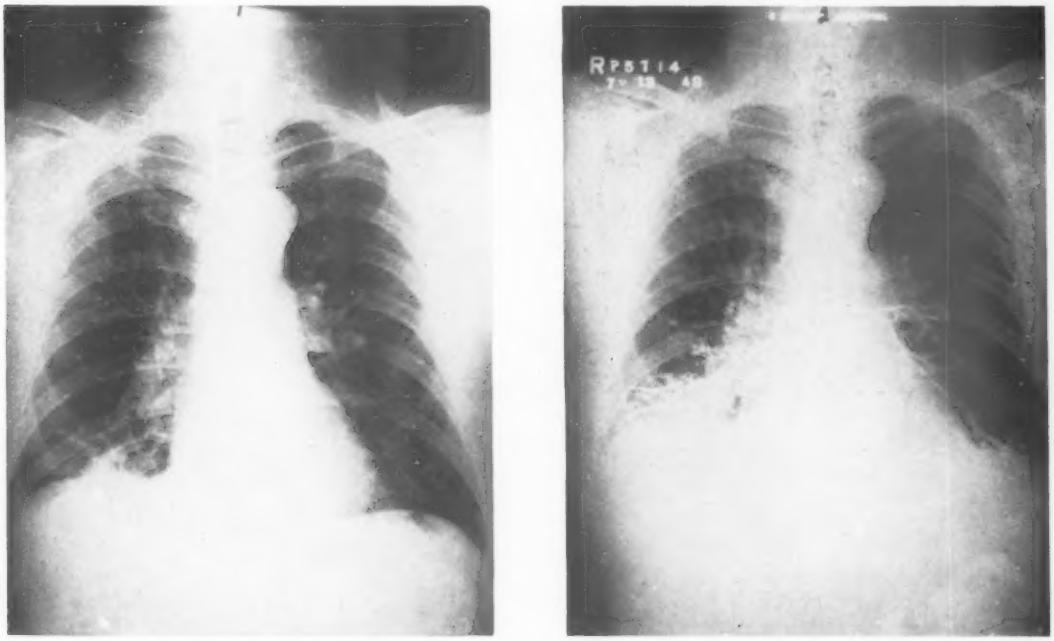
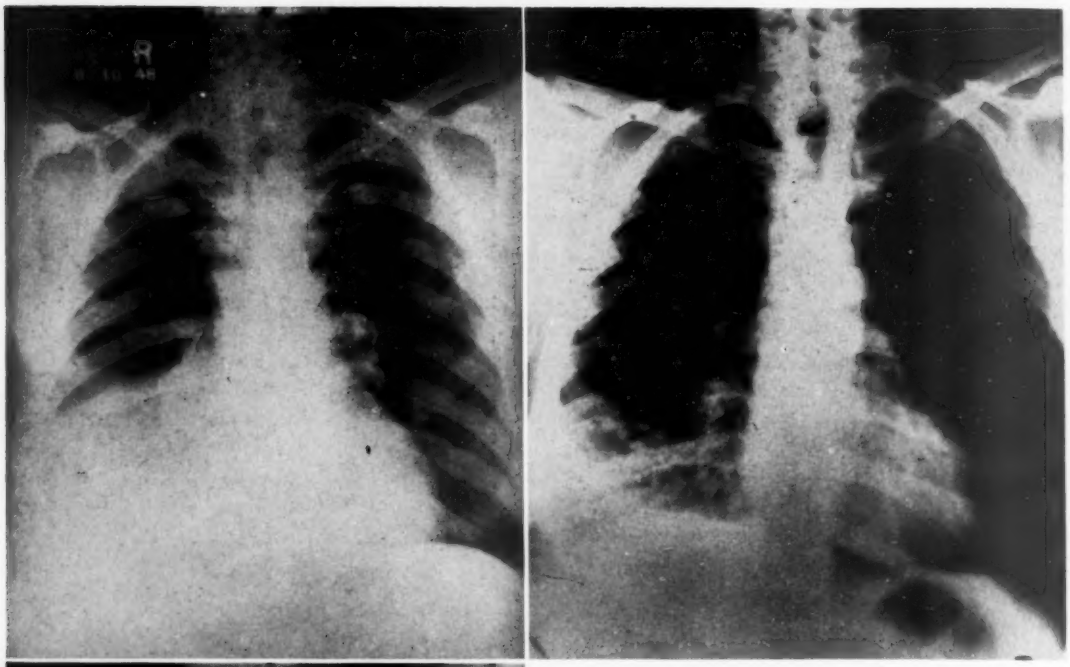


FIG. 12



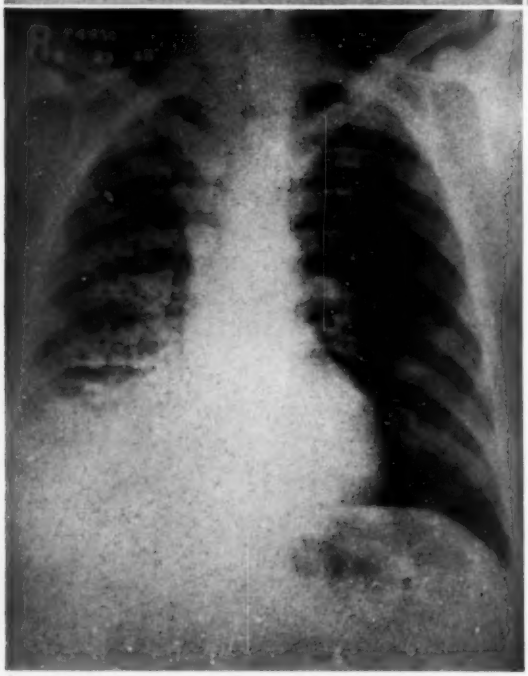


FIG. 13. L. P. This white male, aged forty, gave a history of dyspnea with a productive cough and loss of weight. Bronchoscopy revealed pus coming from the right lower lobe bronchus. A chest film revealed a homogeneous density in the right lower lobe. The impression was that of bronchial obstruction with pleural effusion. A second chest film suggested bronchiectasis with superimposed pneumonitis, following which a right lower lobectomy was performed. Examination at operation revealed small, hard, indurated areas in the right lower lobe. The histopathologic examination revealed bronchiectasis associated with lipoid pneumonia in the right lower lobe, thought to be carcinoma grossly.

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FIG. 15. Case 15. F. M. This white female, aged forty-three, noticed a sudden hemoptysis after exertion. Subsequently she had pain in the right hemithorax, aggravated by coughing.

The first chest roentgenogram revealed a hazy extradensity in the upper lobe with questionable cavity formation. Serial chest films showed slow progression. Bronchoscopy revealed bloody secretions from the right upper lobe orifice. There was no evidence of neoplastic cells or acid fast bacilli in the bronchial aspirations.

At operation, there was a hard mass filling the posterior two-thirds of the right upper lobe. Carcinoma could not be ruled out. Right pneumonectomy was performed. The histopathologic diagnosis was bronchiectasis. Numerous large foam cells in the surrounding pneumonitis prompted the diagnosis of lipoid pneumonia. Healed tuberculosis was also present.

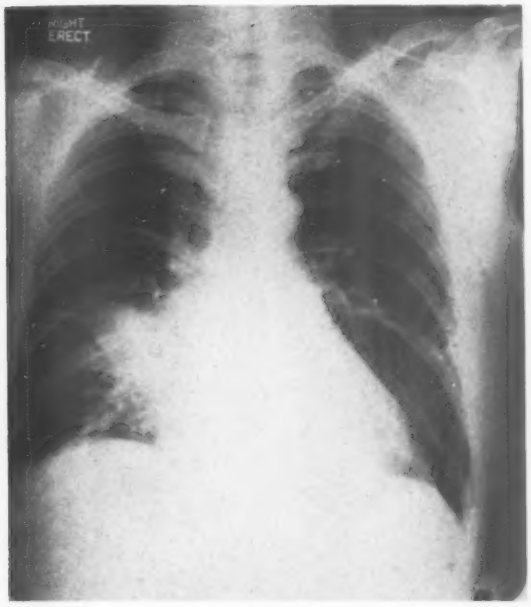


Fig. 14. Case 13. C.E. During a routine roentgen survey this white male, aged forty-six, was found to have a tumor in the right lung. He was asymptomatic. Bronchoscopic examination and aspirated secretions revealed no evidence of neoplasm. There was an irregular shadow of increased density extending into the middle and lower lobes. The initial diagnosis was bronchogenic carcinoma. He was explored surgically because of this and a right pneumonectomy was performed. The surgeon thought that the lesion was cancer. Histopathologic diagnosis was lipoid pneumonia.

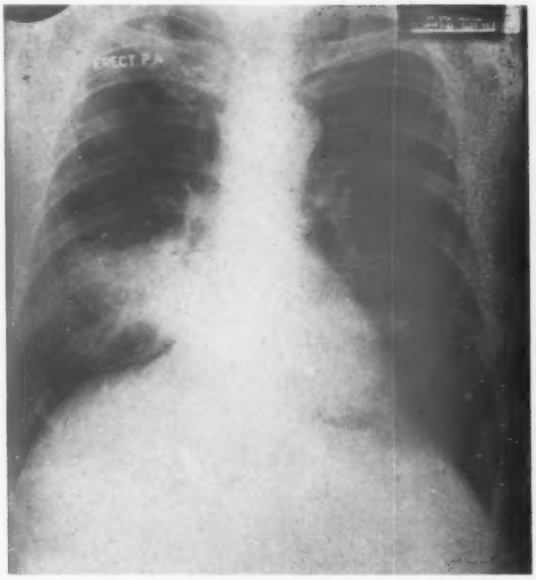
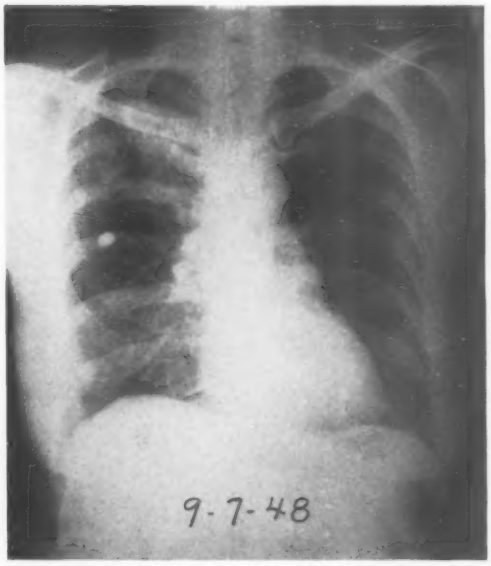


Fig. 16. Case 16. H.G. This white male, aged seventy-five, was told that he had a chest lesion at another hospital. Our initial chest roentgenogram revealed an increased density in the right hilum, extending into the right middle and lower lung fields which suggested neoplasm. In comparison with previous fillms, there was a diminution of the shadow which favored a benign lesion. However, this could have represented an acute inflammatory process, superimposed on a malignant lesion. Initial bronchoscopy revealed no evidence of a malignant process. At a second bronchoscopy, aspirated secretions were reported to show neoplastic cells. The patient was discharged with a probable diagnosis of carcinoma of the lung.



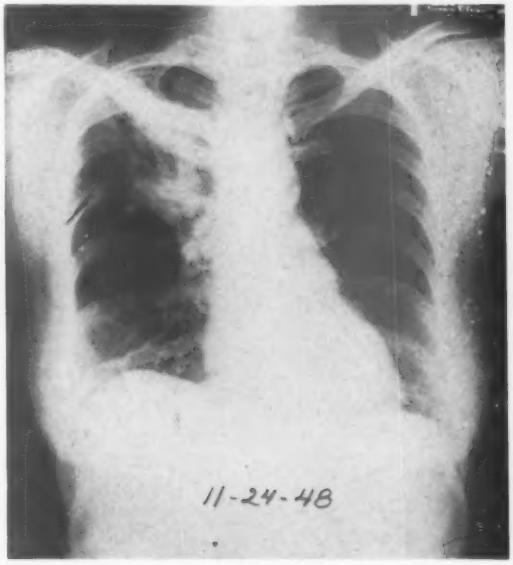


Fig. 15

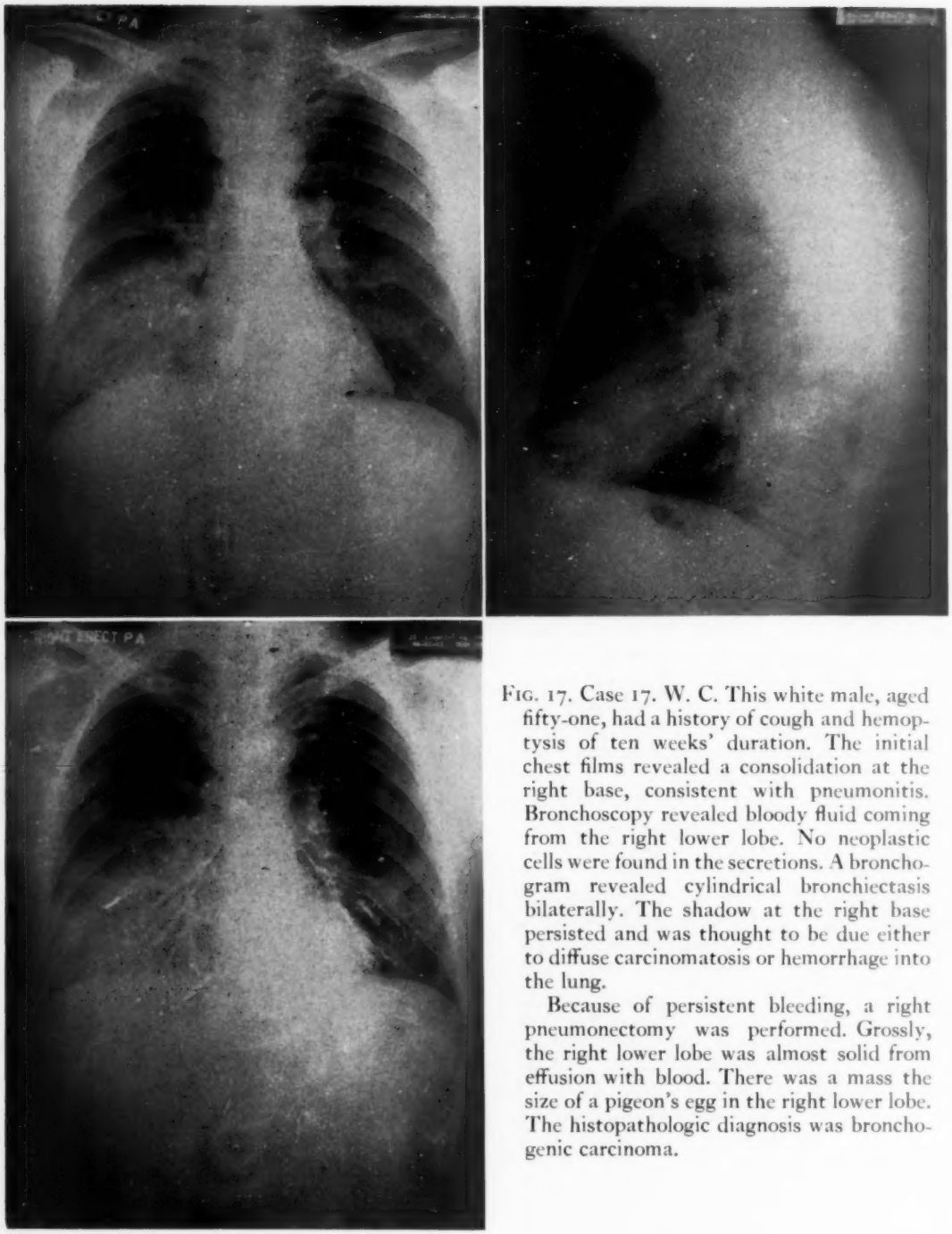


FIG. 17. Case 17. W. C. This white male, aged fifty-one, had a history of cough and hemoptysis of ten weeks' duration. The initial chest films revealed a consolidation at the right base, consistent with pneumonitis. Bronchoscopy revealed bloody fluid coming from the right lower lobe. No neoplastic cells were found in the secretions. A bronchogram revealed cylindrical bronchiectasis bilaterally. The shadow at the right base persisted and was thought to be due either to diffuse carcinomatosis or hemorrhage into the lung.

Because of persistent bleeding, a right pneumonectomy was performed. Grossly, the right lower lobe was almost solid from effusion with blood. There was a mass the size of a pigeon's egg in the right lower lobe. The histopathologic diagnosis was bronchogenic carcinoma.

inflammatory process. How much of the added shadow is pneumonitis, plus neoplasm, or either one alone is difficult to say.

Shadows suggesting suppurations in the pleural space with or without involvement of the adjacent lung parenchyma must always be considered as possible neoplasm until proved otherwise, particularly if occurring after the age of forty; and, further, if the clinical course has been in any way atypical. Organized exudate in a pleural space may simulate a mass lesion and be

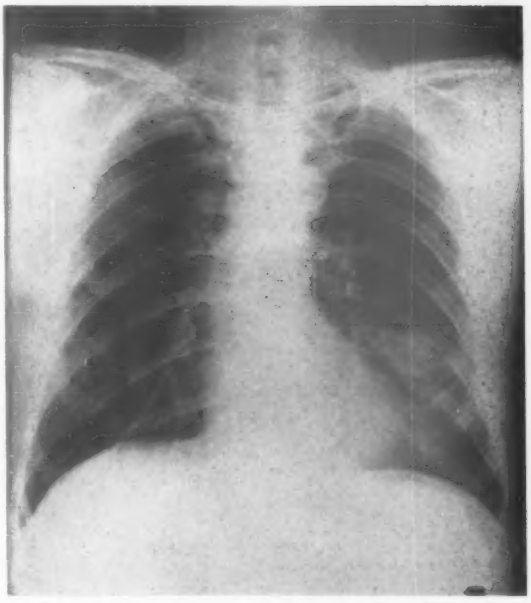


Fig. 18. Case 18. J. A. Bronchoscopic examination on this white male, aged sixty-two, revealed blood-tinged secretions from the left lower lobe bronchus. Aspirated secretions revealed no cancer cells. The roentgen impression was that of a malignant process and thoracotomy was advised. A left pneumonectomy was performed. There was a firm mass in the lingula of the left upper lobe which, on histopathologic examination, proved to be adenocarcinoma, alveolar type.

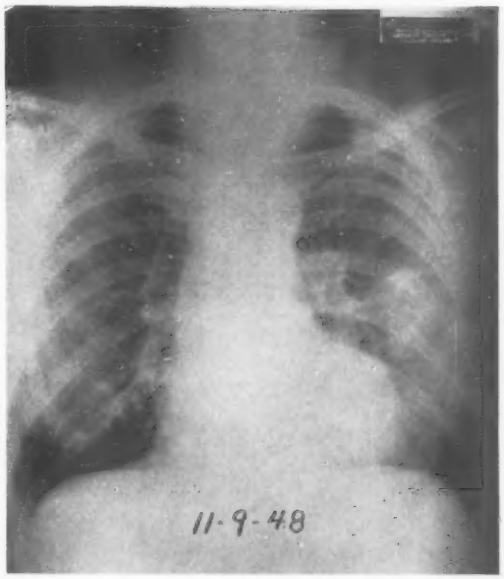


Fig. 19. Case 19. B. C. This Italian male, aged sixty-three, food handler, was found to have "a spot on his lung," on a routine chest examination. Bronchoscopy revealed an obstructing retracting lesion in the left main stem bronchus with blood stained mucopurulent secretions which showed no cancer cells. A chest film on admission revealed a homogeneous extradensity in the left mid-lung field, compatible with neoplasm.

At operation, there was a moderately hard lesion in the left upper lobe. There was no apparent gross mediastinal node involvement. In view of the cancer cells noted in the bronchial secretions, a left pneumonectomy was performed. Grossly, the specimen was described as atypical of carcinoma. An abscess cavity was present. The histopathologic diagnosis was that of bronchogenic carcinoma, squamous cell type, without metastasis.

It will be noted that in most of the foregoing cases, the bronchial secretions failed to aid in the diagnosis. Exploration had to be done on the basis of a suspicious mass lesion.

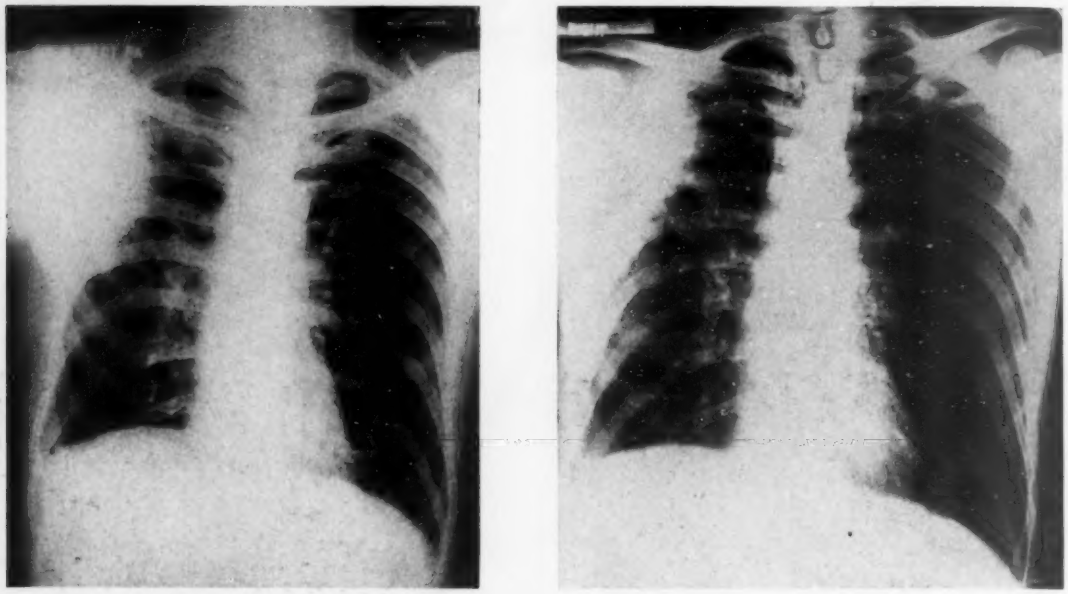


FIG. 20. Case 20. J. S. This machinist, male, aged fifty-six, complained of pain in the right side of the chest of seven months' duration with a productive cough, night sweats and a loss of weight of 32 pounds. He gave a history of excessive use of mineral oil. A chest film revealed a shadow at the periphery of the second and third interspaces on the right, consistent with a tumor. Bronchoscopy was negative.

Exploratory thoracotomy was recommended to rule out carcinoma. A right upper lobectomy revealed a lesion adherent to the thoracic cage. Grossly there was a hard, firm mass in the right upper lobe with a cystic mass attached. Histopathologic examination revealed a pleuropulmonary abscess of the right upper lobe and a healed infarct.

The difficulty in distinguishing this lesion from a peripheral carcinoma is obvious.

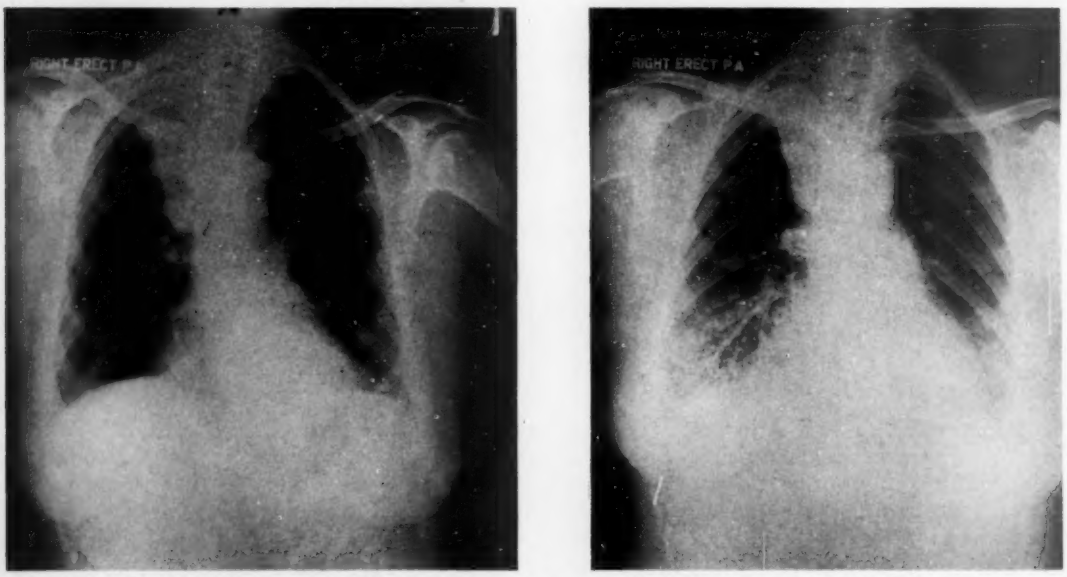


FIG. 21. Case 21. I. S. The initial films on this female, white, aged fifty, revealed a dense shadow in the right upper lobe representing atelectasis with probable underlying tumor. Bronchoscopy was negative on two occasions. A bronchogram did not reveal sufficient evidence to distinguish inflammation from a neoplastic process. Despite the negative cytology, the surgeon suspected a tumor and performed a right pneumonectomy. Grossly, there was complete occlusion of the right upper lobe bronchus. Histopathologic examination revealed atelectasis and bronchiectasis secondary to stenosis of the right upper lobe bronchus.

indistinguishable from it. Here, aspiration biopsy or the exploratory needle to search for fluid may establish a diagnosis.

Pictures identical with a neoplastic bronchostenosis and atelectasis have been seen in a fibrotic constriction of a bronchus due to a non-neoplastic process such as lues or tuberculosis.

It is not uncommon to find a case where there has been incomplete resolution of a Thin walled cavities with fluid within them may be found proximal to bronchostenotic lesions. Closely resembling a cyst or abscess is the cavity with a fluid level resulting from a necrotizing neoplasm.

The neurofibroma of course may have the differential feature of location to help one decide its nature; also characteristic bone destruction in the spine and ribs may be associated with it.

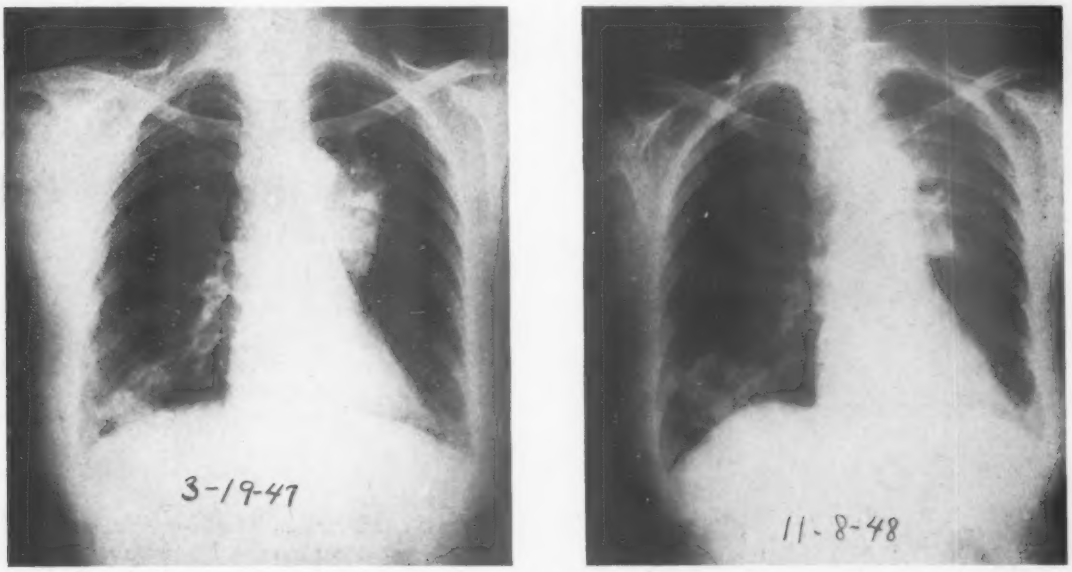


Fig. 22. Case 22. S. M. This white female, aged sixty-six, had a history of radiation therapy for carcinoma of the uterus. She developed a cough and slight expectoration.

Chest films revealed a density in the left hilum which was considered probable bronchogenic carcinoma. There was also a circumscribed mass in the right base which was probably metastatic. Bronchoscopy was negative and no cancer cells were noted in the aspirated secretions. Another chest film revealed multiple neoplasms, any of which might have been malignant. The patient is still being studied as an outpatient.

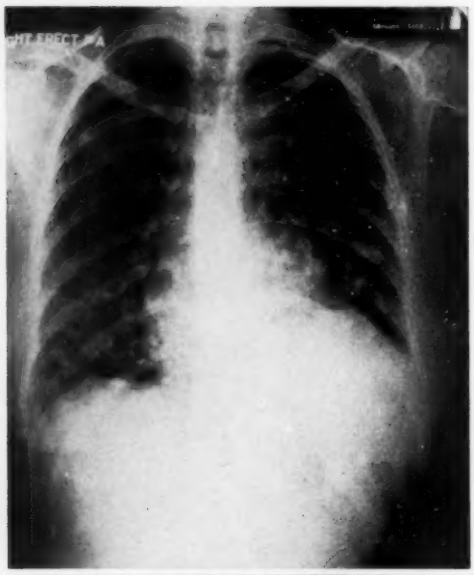
supposed pneumonia or a "cold which has hung on" in which the roentgenogram reveals bronchiectasis or suppuration, and bronchoscopy eventually proves neoplasm as a cause for the atypical course.

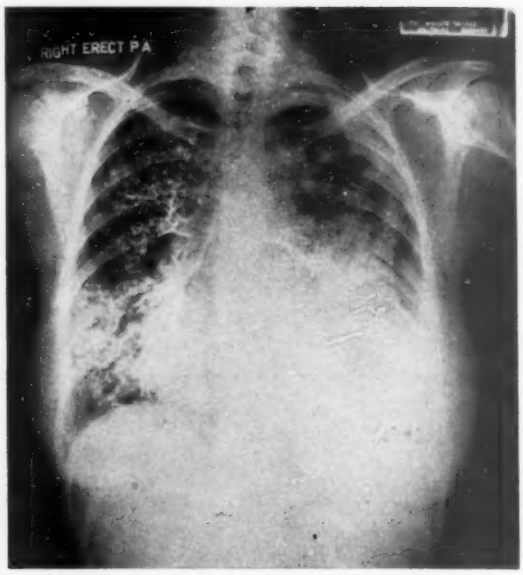
BENIGN NEOPLASMS

Certain benign neoplasms such as lipomas, neurofibromas, chondromas, and adenomas may be indistinguishable from carcinoma of the lung.

Cysts, though not neoplasms in the strict sense of the word, should be mentioned here for they also may complicate the picture.

Recently, we have seen 2 cases of pulmonary adenomatosis at our institution and a number have been reported elsewhere. In our cases the symptoms were masked by a picture resembling a diffuse inflammatory process. There were multiple foci of adenoma located in the lung parenchyma which gradually crowded out normal lung tissue. There is often difficulty in determining whether or not the lesions are those of diffuse alveolar carcinomatosis since the borderline is not sharply drawn between a benign and a malignant process. This condition has a striking resemblance





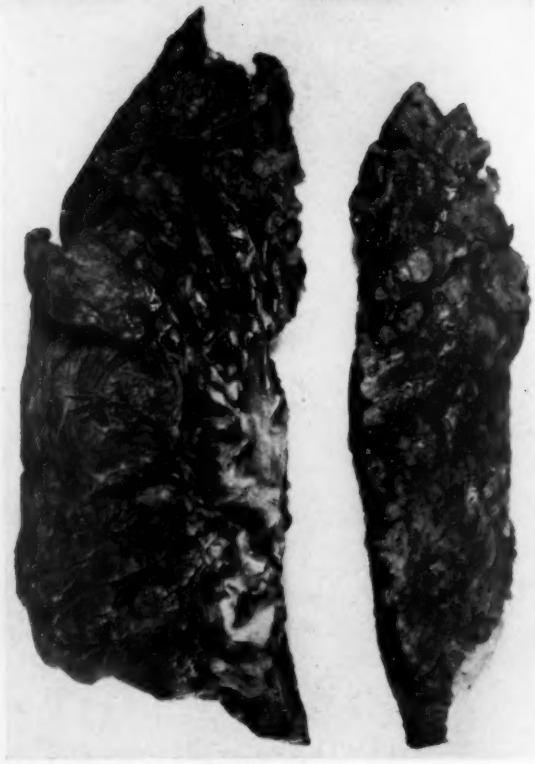


FIG. 23. Case 23. E. R. The initial chest film (part of a mass survey) on this female, white, aged forty-eight, revealed mottled and streaky densities throughout the lower two-thirds of both lung fields, at first considered to be tuberculosis. She was studied extensively, but no evidence of tuberculosis was demonstrated. She noticed pain in the left chest, persistent cough and occasional hemoptysis. Re-examination of the chest revealed a striking change. There was a greater density at the right base, and there appeared to be a hydropneumothorax. Iodized oil injection revealed cylindrical bronchiectasis, but no actual sacculations. She was thought to have acute pneumonitis at the left base with atelectasis and bronchopleural fistula. Bronchoscopy was negative, but aspirated secretions revealed cancer cells.

The impression was now that of a diffuse pulmonary adenomatosis. Nitrogen mustard therapy was started, but soon discontinued because of severe dyspnea. Thoracentesis revealed straw colored fluid repeatedly. The patient apparently died of suffocation. Necropsy was restricted to the left chest. Grossly, there were multiple peribronchial, grayish-white nodules throughout the parenchyma with a left hydrothorax. The histopathologic examination revealed pulmonary adenomatosis.

to an infectious disease of sheep, but there is no etiologic relationship. It may have some relationship to lipoid pneumonia.[2,3,4,10,11,12,13]

MISCELLANEOUS

Vascular lesions, such as infarcts, may resemble a mass lesion, and unless there is good reason to suspect a vascular lesion elsewhere as an exciting cause, exploration may be the only means of distinguishing an infarct from a malignant neoplastic process.

Foreign bodies, such as broncholiths, may produce a stenosis identical with

neoplasm, except that one usually recognizes the absence of a mass located centrally.

Finally, single metastatic malignant lesions, either peripheral or central, have to be considered in the differential diagnosis, and naturally in this case the history of a possible primary lesion elsewhere is all important.

COMMENTS

It will be noted in the series of cases and illustrations which accompany this presentation that the lesions were all of considerable size. It was not a question of whether or not some sort of lesion was present. The abnormalities were quite easily shown roentgenographically. It was merely a question of determining what the shadow represented in terms of gross pathology.

We mention the above, because Rigler[8] has recently emphasized the importance of roentgenoscopic observation in order to demonstrate extremely early changes in the dynamics of respiration before the shadow of any mass lesion is demonstrable. Such an effort is quite salutary, since it will lead to an early diagnosis which can be quite definitely established when bronchoscopy is done. It behooves one to search for these lesions very carefully and thereby bring the case to the bronchoscopist as soon as possible in order to make the diagnosis of a small central lesion. By its very nature, however, such a case is apt to be very difficult to cure because of the deep-seated central position of the lesion.

Our problem in the case of the more easily demonstrable lesion is quite different. Our great task here is that of trying to be certain about the nature of a peripheral lesion since its position gives the hope of successful surgical intervention once the diagnosis is established.

CONCLUSIONS

Until greater refinements in the methods of diagnosis are made, both roentgenologic and otherwise, it seems apparent that there will be need for more exploratory thoracotomies, lobectomies and pneumonectomies. There will be an increasing number of benign lesions removed because of overlapping pathologic characteristics, as well as other uncertainties of diagnosis which do not allow for any delay in action.

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THE ROENTGENOGRAPHIC APPEARANCE OF INTERATRIAL SEPTAL DEFECT

A REPORT OF TWELVE CASES*

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AN INTERATRIAL septal defect is one of the most common congenital cardiac anomalies seen in young adults.[14] As a consequence of this defect, there are alterations in the hemodynamics and anatomical structure of the heart and great vessels. When these structural changes are sufficiently marked, they result in a characteristic roentgenographic picture. In this paper, the roentgenographic appearance of 12 cases of interatrial septal defect will be analyzed in terms of the underlying disturbance in hemodynamics. A differential diagnosis, based on this roentgenographic appearance, will be presented.

METHODS

Diagnosis was established by cardiac catheterization as previously described.[2] The quantities of blood flowing through the lung and the periphery were calculated according to the Fick principle. Pressures in the cardiac chambers and in the pulmonary artery were measured by the Hamilton manometer in all but one case, in which a Sanborn electromanometer was used.[9]

Heart size was measured by the method of Ungerleider and Clark.[16] Changes in the size of the main pulmonary artery and of its hilar and intrapulmonary branches were graded from N to ++++. A similar scale was employed for describing selective cardiac chamber enlargement, as observed in the posteroanterior and oblique projections. Finally, hyperactivity or expansile pulsations of the pulmonary artery, noted at roentgenoscopy, were recorded as + if moderate, and ++ if marked in extent.

Because there is no pediatric service at this hospital, only adults are included in this report. The cases studied ranged in age from ten to fifty-six years.

OBSERVATIONS

Table 1 summarizes the roentgenographic and circulatory changes in 12 patients with interatrial septal defect.

While all of the cases showed evidence of a shunting of oxygenated blood from left to right across the interatrial septum, only 1 case, by virtue of arterial oxygen unsaturation, gave evidence of a net shunt in the reverse direction, i.e., from right atrium to left atrium. This case (Case 1) had a right ventricular output and a pulmonary arterial flow smaller than normal. In all of the remaining cases, the right ventricular output and pulmonary flow was increased owing to the net left-to-right shunt. This increased pulmonary flow ranged between 5.0 and 10.0 liters per minute per square meter of body surface in 6 of the 12 cases, and exceeded 10.0 l/min./sq.m. in the remaining 6 cases. The largest flows were 15, 16, and 19, l/min./sq.m. The normal pulmonary blood flow under identical conditions in this laboratory is 4.2 l/min./sq.m.

In contrast to the large lung flows, the systemic flows were reduced in all but 2 cases.

In 7 cases, the pulmonary arterial and right ventricular systolic pressures were either normal or only slightly elevated, ranging between 18 and 35 mm. Hg. The upper limit of normal in our laboratory is considered to be 30 mm. Hg. Pressures

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TABLE I

ROENTGENOGRAPHIC CHANGES, FLOWS AND PRESSURES IN 12 CASES OF INTERATRIAL SEPTAL DEFECT

Number	Name	Main Pulmonary Artery		Hilar Branches		Chamber Size						Blood Flow l/min.		Blood Flow Shunt Index l/min./sq. m.			Pressures—mm. Hg			
		Size	Activity	Size	Activity	Size of intrapulmonary branches	Heart size	Right ventricle	Right atrium	Left ventricle	Left atrium	Aorta size	Pulmonary	Peripheral	Pulmonary	Peripheral	Left-to-right	Right-to-left	Pulmonary artery	Right ventricle	Right atrial mean	Systemic artery
I	K.R.	++++	++	+++	++	+++	+15%	+N	N	+	N	—	3.2	4.2	2.1	2.8	0.6	1.7	85/30	83/ 2	2	110/65
II	F.S.	++++	?	+++	++	+++	+15%	N	N	+	N	N	7.5	3.2	5.0	2.1	4.3		83/38	83/ 8	8	100/78*
III	E.M.	++++	++	+++		+++	+18%	+	N	+	N	N	9.3	2.7	6.5	1.9	6.6		75/29	72/ 4	4	105/63
IV	S.W.	++++	++	+++	++	+++	+25%	++	++	++	N	N	30.5	3.3	19.3	2.1	27.2		41/21	40/ 5	5	124/80*
V	J.V.	++++	++	++	++	+++	+12%	++	N	N	N	N	34.5	5.1	16.1	2.4	79.4		30/15	38/11	12	126/75
VI	H.C.	++++	+++	+++	++	+++	+35%	++	++	++	N	N	10.8	7.0	5.9	5.8	3.8		38/12	39/−1	2	160/80*
VII	S.L.	++++	++	+++	N	N+	+15%	+	+	N	N	N	14.8	6.2	9.6	4.0	8.6		32/12	32/ 7	10	159/93
VIII	S.Y.	+++	+	+++	+	+++	+30%	+++	+	+	N	N	12.7	3.1	10.4	2.5	9.6		40/20	31/ 6	6	116/76*
IX	V.C.	+++	++	++		++	+25%	N	N	++	N	N	11.0	3.7	7.1	2.4	7.3		24/13	22/ 8	6	122/82*
X	B.K.	+++	++	N	+	N	N	N	N	N	N	N	11.8	3.8	8.6	2.8	8.0		25/11	32/ 7	9	130/76
XI	C.O.	+++	++	N+		++	−10%	N	N	N	N	N	27.9	4.1	15.1	2.2	23.8		15†	31/ 4	3	125/95*
XII	R.S.	N+	N	N+		N+	−10%	N	N	N	N	—	10.9	3.0	7.3	2.0	7.9		27/ 8	30/ 5	4	110/80*

— = Small.
N = Normal.
N + = Prominent but not exceeding outside range of normal.
+ to ++++ = Enlarged.
* = Cuff blood pressure.
† = Saline mean pressure.

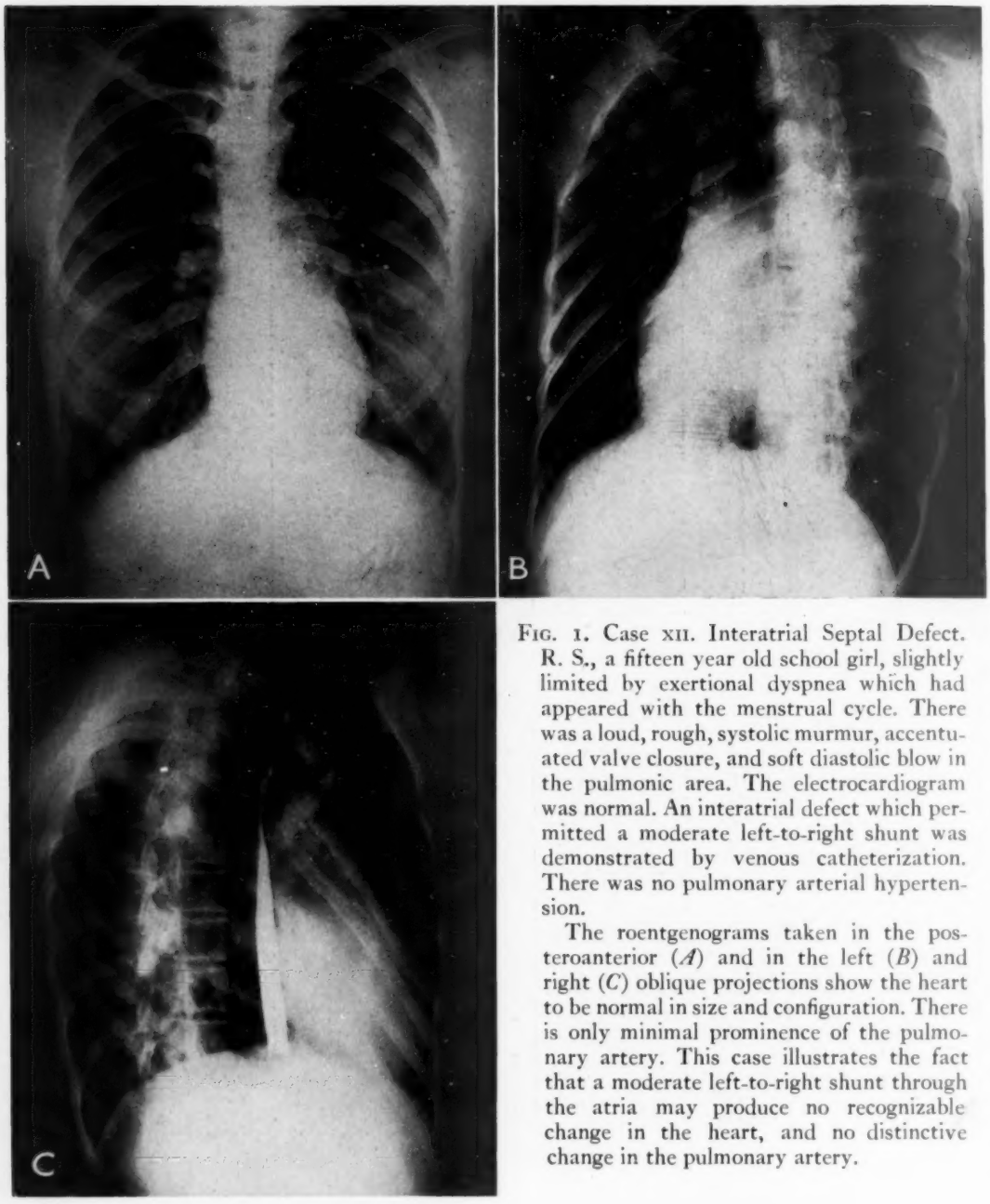

FIG. 1. Case XII. Interatrial Septal Defect. R. S., a fifteen year old school girl, slightly limited by exertional dyspnea which had appeared with the menstrual cycle. There was a loud, rough, systolic murmur, accentuated valve closure, and soft diastolic blow in the pulmonic area. The electrocardiogram was normal. An interatrial defect which permitted a moderate left-to-right shunt was demonstrated by venous catheterization. There was no pulmonary arterial hypertension.

The roentgenograms taken in the posteroanterior (*A*) and in the left (*B*) and right (*C*) oblique projections show the heart to be normal in size and configuration. There is only minimal prominence of the pulmonary artery. This case illustrates the fact that a moderate left-to-right shunt through the atria may produce no recognizable change in the heart, and no distinctive change in the pulmonary artery.

were moderately elevated in 2 cases and in 3 cases there was a severe pulmonary hypertension with pressures of 75/29, 83/38, and 85/30 mm. Hg. The pulmonary blood flows in these 3 cases with the highest pressures were among the smallest recorded in this series. Systemic arterial pressures were slightly elevated in only 2 patients and normal in the rest.

Roentgenographically, there was definite enlargement of the main pulmonary artery in 11 of the 12 cases and in 9 of these it was judged to be hyperactive at roentgenoscopy. Case XII (Table 1) in which the main pulmonary artery was thought to be within normal limits had the smallest pulmonary arterial flow index recorded among those cases in which the pulmonary

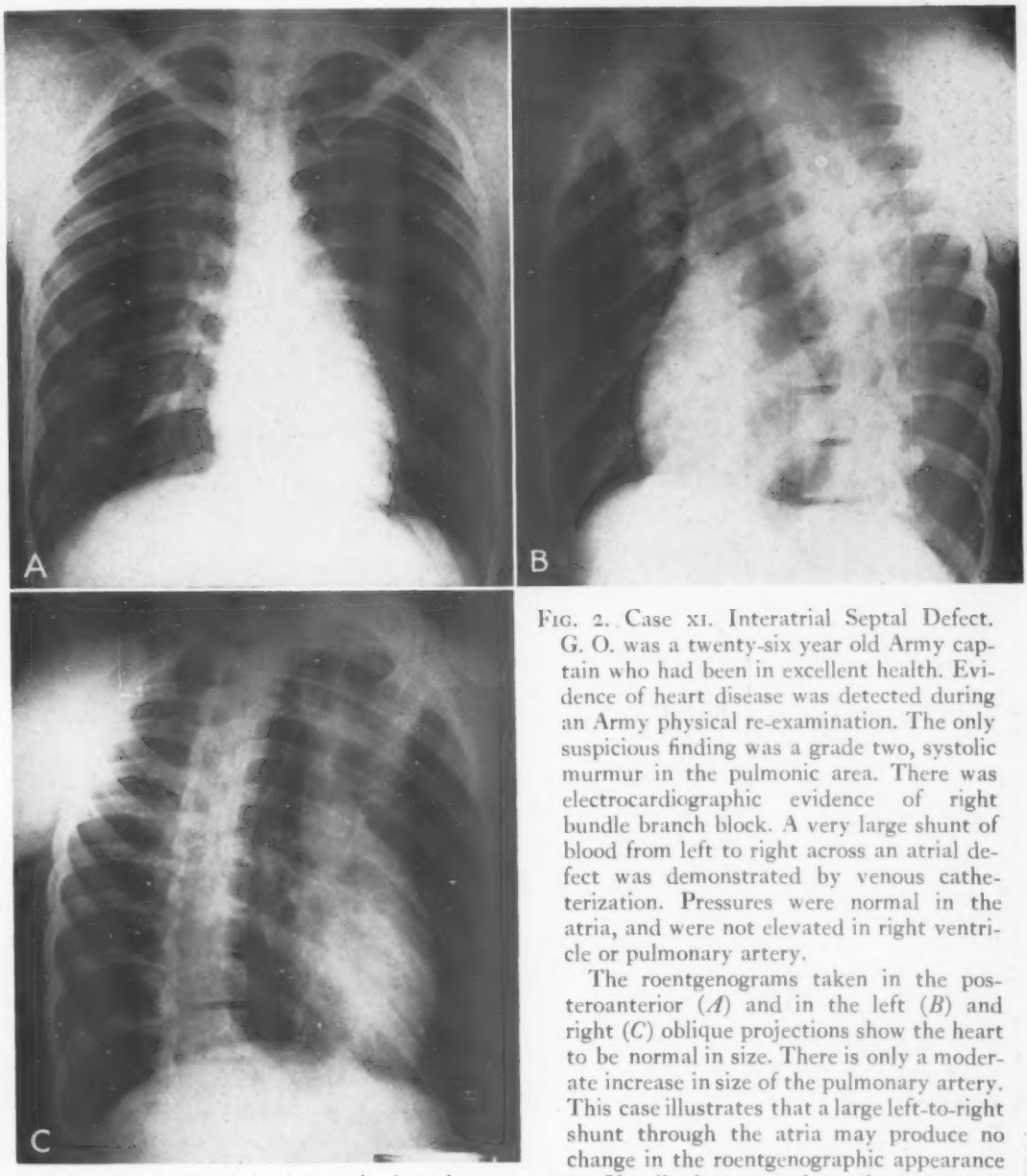

Fig. 2. Case xi. Interatrial Septal Defect. G. O. was a twenty-six year old Army captain who had been in excellent health. Evidence of heart disease was detected during an Army physical re-examination. The only suspicious finding was a grade two, systolic murmur in the pulmonic area. There was electrocardiographic evidence of right bundle branch block. A very large shunt of blood from left to right across an atrial defect was demonstrated by venous catheterization. Pressures were normal in the atria, and were not elevated in right ventricle or pulmonary artery.

The roentgenograms taken in the posteroanterior (*A*) and in the left (*B*) and right (*C*) oblique projections show the heart to be normal in size. There is only a moderate increase in size of the pulmonary artery. This case illustrates that a large left-to-right shunt through the atria may produce no change in the roentgenographic appearance of the heart and only slight changes in the pulmonary artery. Usually, however, a large shunt produces the changes seen in Figure 4.

arterial pressures were either normal or only slightly elevated. The hilar branches were definitely enlarged in 9 instances and there was a definite hilar dance present in 7 of these. Only 1 of the 11 cases that showed enlargement of the main pulmonary artery failed to show either an enlargement of the hilar or of the intrapulmonary branches.

In the presence of an enlarged pulmonary artery, it is difficult to determine aortic size, but in 3 cases the aorta appeared small.

Changes in heart size and chamber configuration were not demonstrable in 3 of the cases and in 1 of these there was a huge shunt present (Case xi). The other 9 cases showed cardiac enlargement varying from

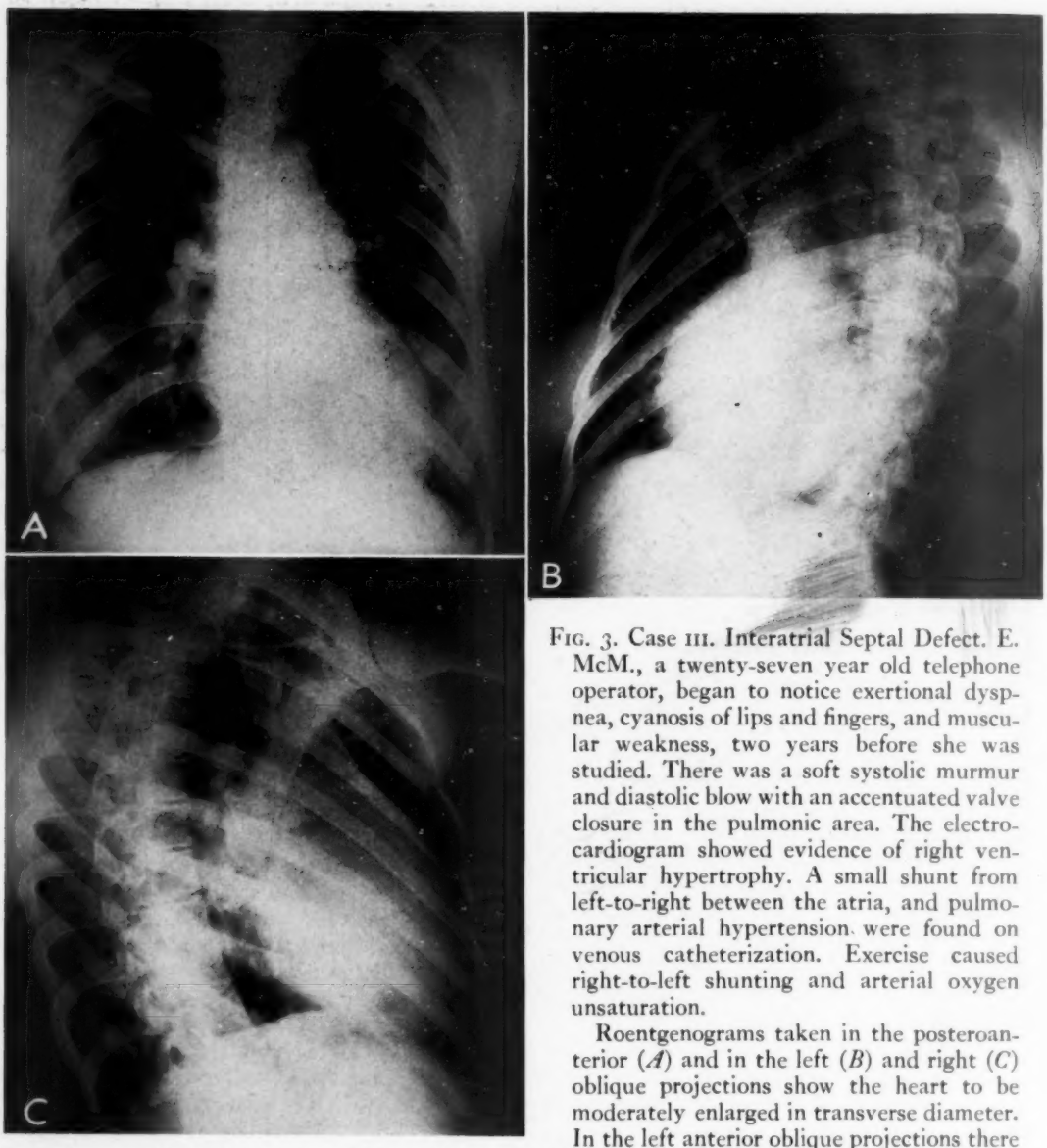

FIG. 3. Case III. Interatrial Septal Defect. E. McM., a twenty-seven year old telephone operator, began to notice exertional dyspnea, cyanosis of lips and fingers, and muscular weakness, two years before she was studied. There was a soft systolic murmur and diastolic blow with an accentuated valve closure in the pulmonic area. The electrocardiogram showed evidence of right ventricular hypertrophy. A small shunt from left-to-right between the atria, and pulmonary arterial hypertension were found on venous catheterization. Exercise caused right-to-left shunting and arterial oxygen unsaturation.

Roentgenograms taken in the posteroanterior (*A*) and in the left (*B*) and right (*C*) oblique projections show the heart to be moderately enlarged in transverse diameter. In the left anterior oblique projections there is prominence of both the right and left ventricles. The left auricle is not enlarged. There is marked enlargement of the main pulmonary artery and of its hilar and intrapulmonary branches. This is the characteristic roentgenographic picture of an interatrial septal defect. In this instance it is the result of a small left-to-right shunt with marked pulmonic hypertension. Compare with Figure 4 where similar changes result from a large left-to-right shunt without marked pulmonic hypertension.

12 per cent to 35 per cent above average. The right ventricle appeared enlarged in 8 cases. The left ventricle also appeared enlarged in 7 cases, but the electrocardiographic findings in these cases (right ventricular hypertrophy, right bundle branch block, or right axis deviation) suggested only right ventricular involvement. The right atrium was observed to be large in 5 cases. There was no demonstrable enlargement of the left atrium in any of the cases.

DISCUSSION

Three basic disturbances of the circulation in interatrial septal defect may occur to produce changes in the roentgen picture.

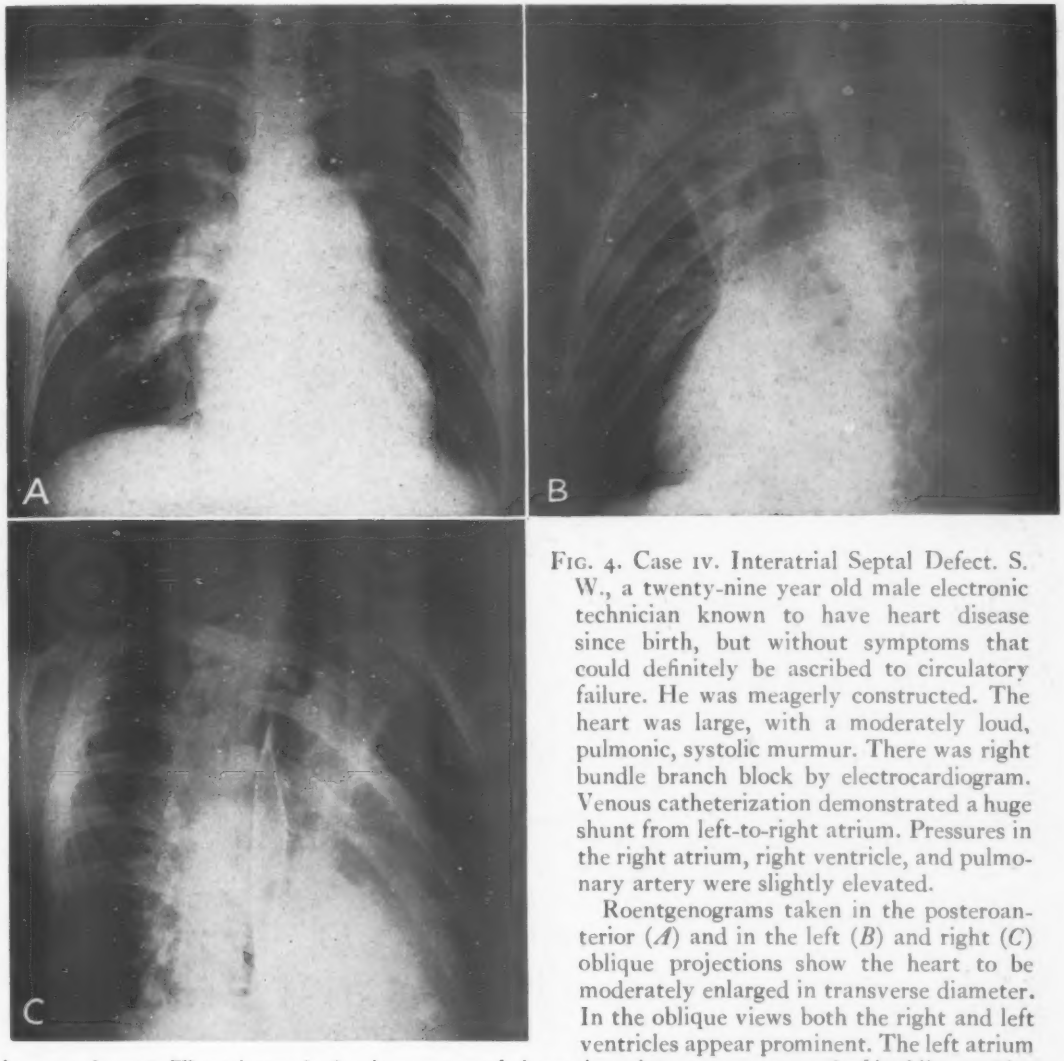

Fig. 4. Case IV. Interatrial Septal Defect. S. W., a twenty-nine year old male electronic technician known to have heart disease since birth, but without symptoms that could definitely be ascribed to circulatory failure. He was meagerly constructed. The heart was large, with a moderately loud, pulmonic, systolic murmur. There was right bundle branch block by electrocardiogram. Venous catheterization demonstrated a huge shunt from left-to-right atrium. Pressures in the right atrium, right ventricle, and pulmonary artery were slightly elevated.

Roentgenograms taken in the posteroanterior (*A*) and in the left (*B*) and right (*C*) oblique projections show the heart to be moderately enlarged in transverse diameter. In the oblique views both the right and left ventricles appear prominent. The left atrium is not enlarged. There is marked enlargement of the main pulmonary artery and of its hilar and intrapulmonary branches. Roentgenoscopy showed a hyperactive main pulmonary artery and a true "hilar dance." This is the characteristic roentgenographic picture of an interatrial septal defect which permits a large left-to-right shunt.

The nature and pathogenesis of these disturbances are described elsewhere[4] and may be briefly summarized as follows: (1) Through the atrial defect there is a net shunting of blood from left to right and a corresponding increase in the volume of blood flowing through the entire lesser circulation. Under these circumstances, the chambers of the right heart perform more work than normally.[10] Dilatation and hypertrophy of the right atrium and ventricle and dilatation of the pulmonary artery follow; the left ventricle and the aorta remain normal or small. (2) Pulmonic hypertension, a common complication of interatrial defect, may be a result of increased blood flow through the lung or of increased resistance to blood flow through the arterioles of the lung. Regardless of the cause, this further increases the work of the right side of the heart without affecting the left ventricle. Such pressure elevations are associated with enlargement of the pulmonary artery. Resistance to the flow of blood

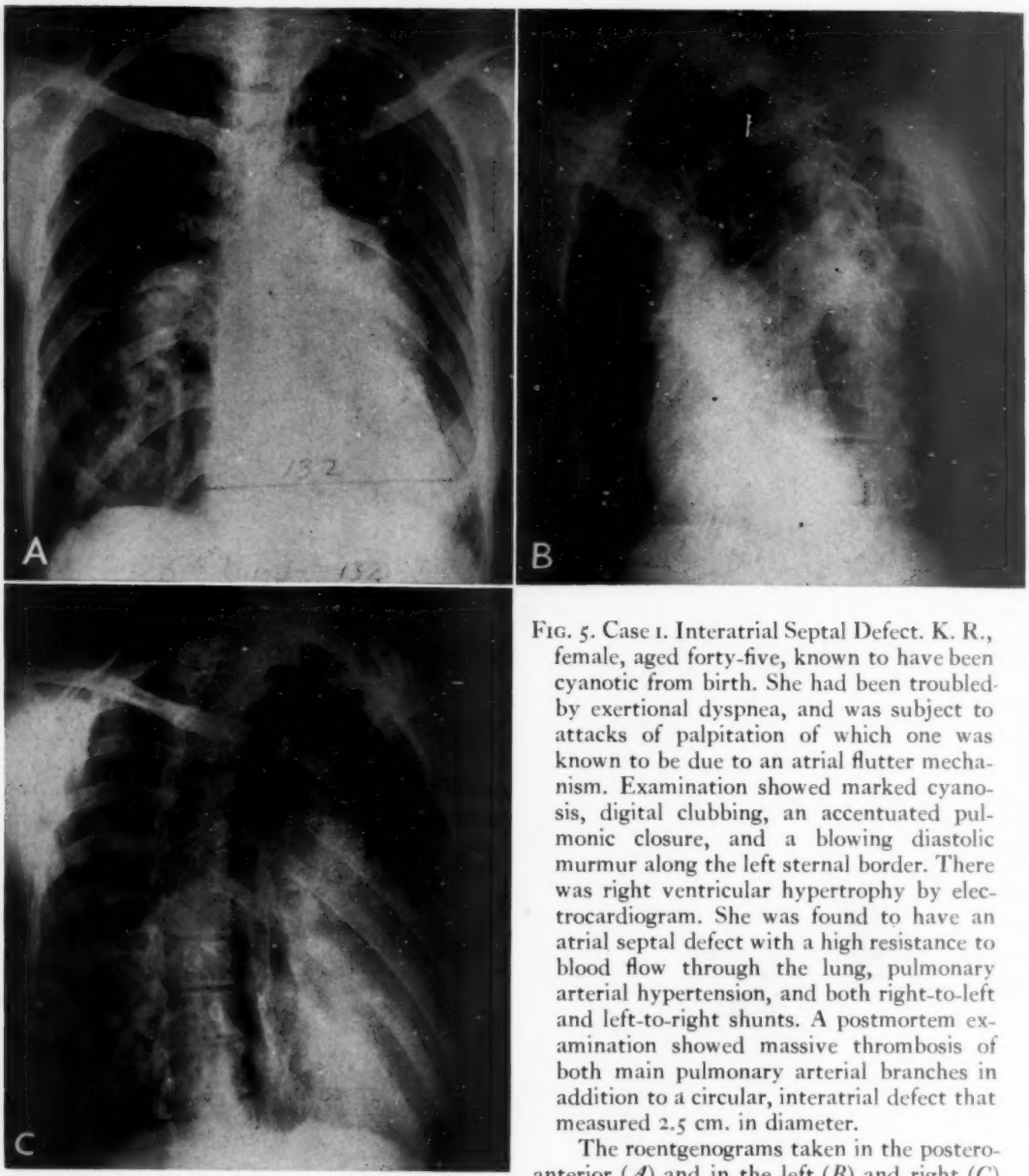

FIG. 5. Case 1. Interatrial Septal Defect. K. R., female, aged forty-five, known to have been cyanotic from birth. She had been troubled by exertional dyspnea, and was subject to attacks of palpitation of which one was known to be due to an atrial flutter mechanism. Examination showed marked cyanosis, digital clubbing, an accentuated pulmonic closure, and a blowing diastolic murmur along the left sternal border. There was right ventricular hypertrophy by electrocardiogram. She was found to have an atrial septal defect with a high resistance to blood flow through the lung, pulmonary arterial hypertension, and both right-to-left and left-to-right shunts. A postmortem examination showed massive thrombosis of both main pulmonary arterial branches in addition to a circular, interatrial defect that measured 2.5 cm. in diameter.

The roentgenograms taken in the postero-anterior (*A*) and in the left (*B*) and right (*C*) oblique projections show the heart to be moderately enlarged in the transverse diameter. Both the right and left ventricles appear enlarged. The left atrium is not enlarged. There is aneurysmal dilatation of the main pulmonary artery and of its hilar branches. These structures showed marked systolic expansile pulsations at roentgenoscopy. There was moderate enlargement of the intrapulmonary vessels. This case demonstrates the extreme pulmonary arterial changes that may occur in an atrial septal defect with a net right-to-left shunt and marked pulmonic hypertension. These changes may also be seen in the Eisenmenger complex.

through the lung may become so great that right ventricular output falls below that of the left ventricle and the net shunt is reversed, as was seen in Case 1 of this series. (3) The effect of mitral stenosis, which is not a rare co-existing lesion, is to increase the net left-to-right shunt and to distend the left atrium.

The anatomical consequences of a defect in the interatrial septum are well known.

Roesler[11] reviewed 62 cases of interatrial septal defect and found that practically all of the hearts were large or very large. The enlargement affected only or predominantly the right heart chambers. Hypertrophy and dilatation of these structures were the rule. The pulmonary artery was usually large; the aorta was usually small, but occasionally normal. Lesions of the heart valves were frequent in Roesler's series.

McGinn and White[7] reviewed 23 autopsied cases of interatrial septal defect complicated by mitral stenosis (Lutembacher's syndrome). Left atrial enlargement was frequently present in these cases.

The roentgenographic appearance of interatrial septal defect has been described frequently.[1,7,8,11,12,14,15] Descriptions have included: (1) cardiac enlargement due primarily to right atrial and right ventricular enlargement. Both Taussig[14] and Roesler[11] have emphasized that an enlarged right ventricle may displace the left ventricle to the left and posteriorly, thus simulating left ventricular enlargement on the roentgenogram; (2) enlargement of the main pulmonary artery and of its hilar and intrapulmonary branches; (3) expansile pulsations of the main pulmonary artery and of the hilar branches; (4) a relative or absolute smallness of the aortic knob; (5) the usual absence of demonstrable left atrial enlargement. It is evident from Table I that the observed roentgenographic changes in the 12 cases included in this report were similar to those described by others.

Additional information may be gained from a correlation of the roentgenographic and hemodynamic changes present in these cases.

(1) A moderate left-to-right shunt through the atria, in the absence of pulmonic hypertension, may not produce a recognizable change in the roentgenographic appearance of the heart or great vessels. Case XII (Fig. 1) illustrates this point.

(2) A large left-to-right shunt usually produces the characteristic roentgenographic picture described above. Case XI (Fig. 2) is the exception to this rule, for despite a large shunt, there was no increase in heart size or change in its configuration. Only slight pulmonary arterial enlargement was present. The intrapulmonary branches were prominent.

FIG. 6. The Complex of Eisenmenger. C. S., a thirty-five year old taxi dispatcher who had been found to have heart disease while in the Army, four years before study. He had since been troubled by syncopal episodes, and by progressive exertional dyspnea. There had been a single hemoptysis. There were pulmonic systolic and diastolic murmurs, and an accentuated valve closure in that area. The electrocardiogram showed right ventricular hypertrophy. Observations made by venous catheterization were considered to be consistent with the Eisenmenger complex. There was pronounced pulmonary arterial hypertension with an ordinary pulmonary blood flow.

The roentgenogram shows the heart to be moderately enlarged. The appearance of the heart and pulmonary artery is identical to that seen in the preceding cases. The Eisenmenger complex cannot be distinguished from an interatrial septal defect on routine roentgenograms.

(3) A small left-to-right shunt with marked pulmonic hypertension and a large left-to-right shunt without marked pulmonic hypertension have the same roentgenographic appearance. This point may be demonstrated by a comparison of Case III (Fig. 3) with Case IV (Fig. 4).

(4) The enormous dilatation of the pulmonary artery described by Taussig[13] as characteristic of the Lutembacher syn-

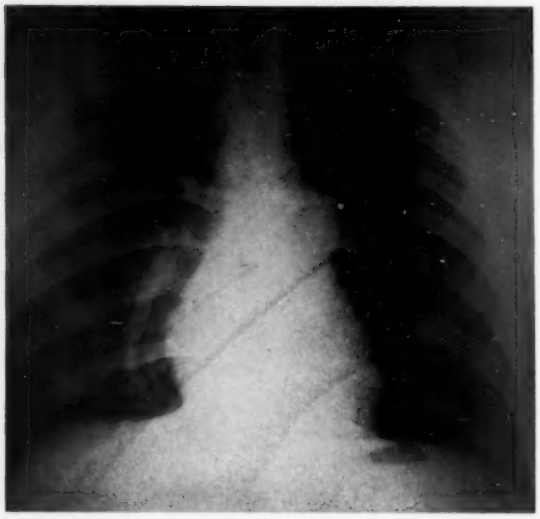

FIG. 7. Cor Pulmonale. L. S., a twenty-two year old student, whose history was consistent with multiple pulmonary embolization following extensive venous thrombosis. Examination was essentially normal. There was electrocardiographic evidence of right ventricular hypertrophy. There was no demonstrable anomaly of the circulation by venous catheterization. Resistance to blood flow through the lung was high, and there was pulmonary arterial hypertension.

Comparison of Figure 7 with Figures 3 and 4 demonstrates the roentgenographic similarity of a cor pulmonale resulting from increased pulmonary arteriolar resistance and an interatrial septal defect.

drome may occur in the absence of mitral stenosis. Case 1 (Fig. 5) the only case in this series with a marked pulmonic hypertension and a net right-to-left shunt, had an enormously dilated pulmonary artery, but autopsy failed to disclose a lesion of the mitral valve.

DIFFERENTIAL DIAGNOSIS BASED ON THE ROENTGENOGRAPHIC APPEARANCE

Any circulatory abnormality which results in an increased resting blood flow or pressure in the pulmonary circuit without an accompanying disturbance in the systemic circuit will produce a roentgenographic picture indistinguishable from that of interatrial septal defect.

In the complex of Eisenmenger and in cor pulmonale resulting from a primary pulmonary arteriolar obstruction, the work of the right heart is increased, while that of the left is usually not altered significantly.[3] In each instance there may be dilatation of the pulmonary artery and expansile pulsations of the hilar vessels.[5] The resulting roentgenographic picture in Eisenmenger's complex (Fig. 6) and in cor pulmonale (Fig. 7) may be identical with that of interatrial septal defect.

Mitral stenosis may be distinguished from uncomplicated interatrial septal defect by the presence of left atrial enlargement. However, mitral stenosis may complicate an atrial defect and, if sufficiently

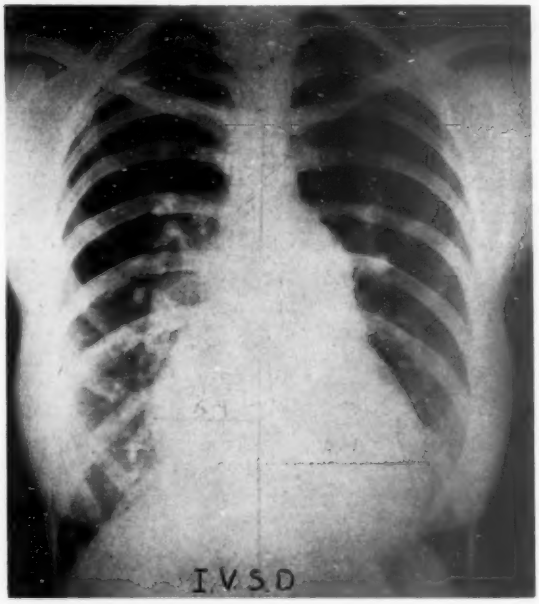

FIG. 8. Interventricular Septal Defect. E. P., a twenty-two year old girl, who was found to have a murmur at two and a half years. She had limited her activity on advice. The heart was large. There was a very loud and rough systolic murmur with thrill maximal along the left sternal border, and a short, pulmonic, diastolic blow. The electrocardiogram showed right bundle branch block. Venous catheterization demonstrated a large shunt from the left ventricle to the right ventricle and very definite pulmonary arterial hypertension.

Comparison of Figure 8 with Figures 3 and 4 demonstrates the roentgenographic similarity of a large isolated ventricular septal defect and an interatrial septal defect. Roentgenoscopy shows an enlarged left atrium in this patient, but even this finding might be present in an interatrial septal defect complicated by mitral stenosis (Lutembacher's syndrome).

severe, may cause left atrial enlargement.[1] Thus, an interatrial defect complicated by severe mitral stenosis may be indistinguishable roentgenographically from mitral stenosis alone.

The absence of enlargement of the hilar and peripheral branches of the pulmonary artery in pulmonic stenosis serves to distinguish this anomaly from interatrial septal defect with a fair degree of accuracy.[6] Nevertheless, Case x of this series was erroneously diagnosed on the roentgenogram as mild pulmonic stenosis because the main pulmonary artery was dilated without a corresponding dilatation of the hilar or intrapulmonary branches.

The tetralogy of Fallot does not resemble an interatrial septal defect. In the former, the pulmonary artery is usually either normal or small in size. Even in the unusual case when there is enlargement of the main pulmonary artery, there is no dilatation or hyperactivity of its hilar or intrapulmonary branches to suggest an atrial septal defect.

Cardiac enlargement plus enlargement and hyperactivity of the pulmonary artery may occur in patent ductus arteriosus. Roentgenographic evidence of only left ventricular enlargement in this condition, if verified by the electrocardiogram, will exclude an interatrial septal defect. The left atrial enlargement frequently present in patent ductus arteriosus may not always serve to distinguish these two anomalies, for a severe mitral stenosis complicating an interatrial septal defect may also distend the left atrium.

An isolated ventricular septal defect usually produces no change in the appearance of the heart or great vessels. Rarely, however, it may closely resemble an interatrial septal defect (Fig. 8).

SUMMARY

An analysis was made of the roentgenographic and hemodynamic changes observed in twelve cases of interatrial septal defect.

Significant roentgenographic findings included cardiac enlargement, right atrial and right ventricular enlargement, and dilatation and hyperactivity of the pulmonary artery. The aorta appeared small in three cases. Left atrial enlargement was not observed. In seven cases, posterior enlargement of the right ventricle simulated left ventricular enlargement.

A correlation of the roentgenographic appearance with the hemodynamic changes revealed that a small left-to-right shunt through an atrial defect produced no recognizable changes in the heart or pulmonary artery. A large shunt usually resulted in marked changes, but an exception was noted. Small interatrial shunts associated with marked pulmonic hypertension were indistinguishable roentgenographically from large interatrial shunts without marked pulmonic hypertension. Aneurysmal dilatation of the pulmonary artery, usually associated with Lutembacher's syndrome, was found in one case without a lesion of the mitral valve at necropsy.

A differential diagnosis based on the roentgenographic appearance is given.

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Vol. 63, No. 5

THE VALUE OF TANNIC ACID ENEMA AND POST-EVACUATION ROENTGENOGRAMS IN EXAMINATION OF THE COLON*

By ARTHUR C. CHRISTIE, M.D., FRED O. COE, M.D., AUBREY O. HAMPTON, M.D., *and* GEORGE M. WYATT, M.D.

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THE problem of rectal bleeding and the necessity for careful roentgen examination of the colon has long been recognized, and numerous refinements and modifications of the barium enema examination have been proposed. Frequently these modifications have been reported as constituting an adequate examination in themselves. Increasing knowledge and experience, however, indicate that no one method is infallible and that in many instances all methods are required. Swenson and Wigh[6] have recently emphasized the responsibility of the roentgenologist and have summarized the procedures of roentgen examination of the colon as follows:

1. Filling of the colon by a barium and water mixture under roentgenoscopic observation with palpation of the colon.
2. Roentgenograms of the full colon.
3. Post-evacuation roentgenograms of the colon.
4. Insufflation of the colon by air followed by air contrast roentgenograms.
5. Compression spot films of suspicious segments of the colon.

In addition to the above maneuvers the use of tannic acid in the barium enema has recently been advocated.[3]

A small lesion of the colon may be demonstrated by all of these methods or it may be detected by only one of them. In any event the investigation cannot be considered adequate until a lesion is demonstrated or all methods of examination have been exhausted.

This paper is primarily concerned with the diagnosis of small carcinomas and polyps of the colon by means of roentgenological examination with emphasis on the use of tannic acid in the barium enema mixture. There are many sources of rectal bleeding including numerous benign conditions, such as hemorrhoids, colitis and Meckel's diverticulum. Investigation of rectal bleeding includes history, inspection of the anus, digital examination of the rectum and anal canal, proctoscopy, sigmoidoscopy, laboratory examination of the stool and roentgenological examination. In too many instances patients have been treated for bleeding hemorrhoids where an unsuspected carcinoma or polyp of the colon has been the major lesion. It is an encouraging sign that surgeons now frequently request a barium enema study of patients who have rectal bleeding in the presence of hemorrhoids.

The authors' series consists of 40 polyps and 38 carcinomas of the colon. Rectal bleeding was present in 30 of the polyp cases and in 20 of the carcinoma cases. Its duration varied from a single recent episode to intermittent rectal bleeding for thirty years. The series was collected over a period of eighteen months during which time 4,225 barium enemas were administered. Of the polyps, 24 were benign and 10 were malignant microscopically. All were grossly benign. Six of the patients were not operated upon for various reasons, but polyps were found in all patients who underwent surgery with such a roentgenological diagnosis (Table 1).

The incidence of malignancy in polyps varies with the pathologist's method of classification and ranges from 6.5 per cent[4] to 62.5 per cent.[2] Accumulated evidence,

* From The Radiological Clinic of Drs. Groover, Christie and Merritt, Washington, D. C. Presented at the Fiftieth Annual Meeting, American Roentgen Ray Society, Cincinnati, Ohio, Oct. 4–7, 1949.

however, indicates that all polyps of the colon are potentially malignant and that many carcinomas were originally grossly benign polyps.[8] About 50 per cent of polyps are visible sigmoidoscopically, but since polyps are sometimes multiple, visualization of a polyp should be followed by roentgenological examination.[7] It is important to note that in the series here reported only

TABLE I

SUMMARY OF FORTY CASES OF POLYPS OF THE COLON

Age	Oldest	73 years
	Youngest	3 years
	Mean	50 years
Sex	Male	16
	Female	24
History of rectal bleeding	Bleeding	30
	Not bleeding	9
	No history obtained	1
Period of bleeding	Single episode	5
	Longest	30 years
		Intermittent
Pathological findings	Benign	24
	Malignant	10
	No operation	6
Additional tumors of colon	Carcinoma elsewhere	4
	Polyps of colon elsewhere	2

two of the polyps were seen proctoscopically. Removal of a polyp is one of the few procedures in medicine today whereby it may be affirmed confidently that cancer is prevented.

Large carcinomas of the colon are easily diagnosed by means of the barium enema. Unfortunately, metastasis has frequently occurred by the time the carcinoma manifests itself as a constricting or obstructing lesion, or one that produces a readily demonstrable filling defect. On the other hand, the most consistent symptom of the precancerous polyp is rectal bleeding. A physician whose patient has unexplained rectal bleeding accepts a grave charge to exhaust every possibility in investigation of the source of blood. Examination of the colon by barium enema is an essential part of this investigation, and it must be stressed that a single negative routine barium enema does not constitute thorough investigation. In only 7 of the cases in this series was a single examination considered adequate. In each of the remaining cases at least two barium enemas were given (Fig. 3).

METHOD OF EXAMINATION

One of the prime requisites for a satisfactory roentgen examination is a clean bowel and there is only one way to obtain this, namely, by drastic catharsis. We prefer castor oil (1 to 2 ounces) administered about sixteen hours before examination and followed by a cleansing enema about three hours before examination. The patient is requested to report the number of bowel movements achieved. The referring physician is frequently reluctant to have a drastic cathartic administered in the presence of severe rectal bleeding, but this is one instance in which *caution may defeat its purpose*. An initial barium enema may be administered without preparation but if this is negative the bowel should be thoroughly cleansed, even if it means that the patient must be hospitalized and given blood transfusions. Assuming that the bowel is clean, the following procedure is recommended:

Roentgenoscopy with palpation during the administration of the barium enema. This involves turning the patient from side to side, tilting the table, manipulating the colon through the abdominal wall and performing any other maneuver which will aid in the inspection of each segment. It is obvious that various positions are necessary to separate overlapping coils of intestine and prevent obscuration of small lesions by overlying barium.

Spot roentgenograms taken during the course of roentgenoscopy are an essential part of the examination (Fig. 3 and 5). On

numerous occasions such films have been the only substantiation of roentgenoscopic findings. Evidence of a lesion recorded on films is more reliable than roentgenoscopic observation alone and, in addition, furnishes an important permanent record. The pedicle of a polyp is often seen only on the compression spot films and its demgm. of barium per 100 cc. of water produce no significant change in the total volume. *The tannic acid should, however, be as accurately weighed as any other medication.* Too low a concentration will give no effect and too high a concentration will cause patients to faint in the bathroom from excessive abdominal cramps. *The results are threefold:*

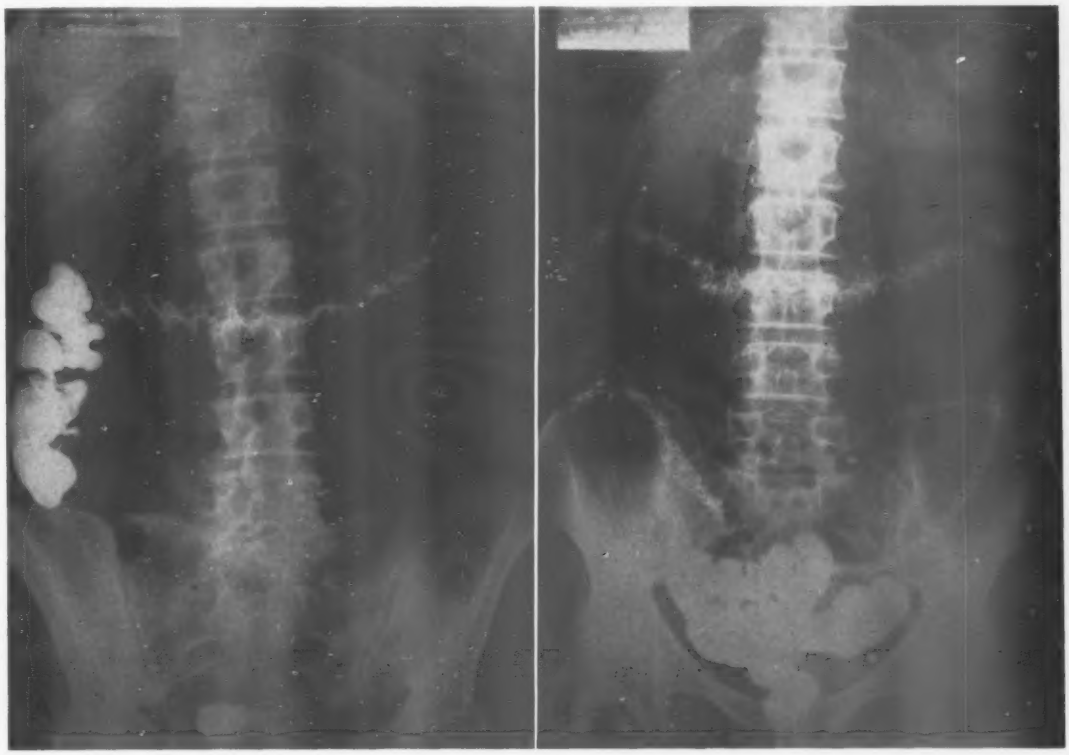

FIG. 1. (*A*) Post-evacuation roentgenogram without tannic acid, showing the ascending colon full of barium, a mucosal pattern of the transverse colon and an empty descending and sigmoid colon. (*B*) Post-evacuation roentgenogram with tannic acid, showing mucosal pattern of entire completely contracted colon. The sigmoid colon is partially obscured by barium which has refluxed into the distal ileum. Such reflux occasionally necessitates re-examination of the sigmoid colon.

onstration is the most dependable single point of differentiation between a polyp and feces or an air bubble.

Tannic acid and post-evacuation roentgenograms. The addition of tannic acid to the barium enema mixture, 1 gram of tannic acid to 100 cc. of the barium and water mixture, constitutes a vital step in a complete examination. For practical purposes, the enema mixture may be considered completely fluid. Barium displaces such a small volume of water that variations of 10 to 30 the mixture is sufficiently irritating to stimulate contraction of the entire colon; the tannic acid is astringent and thereby inhibits secretion of mucus; the tannic acid solution has the physical property of viscosity by virtue of which it causes the barium to adhere to the bowel wall. The summation of these effects results in a uniform coating of the mucosa of the completely contracted colon (Fig. 1). It is obvious that any space-occupying lesion larger than about 1 centimeter in diameter

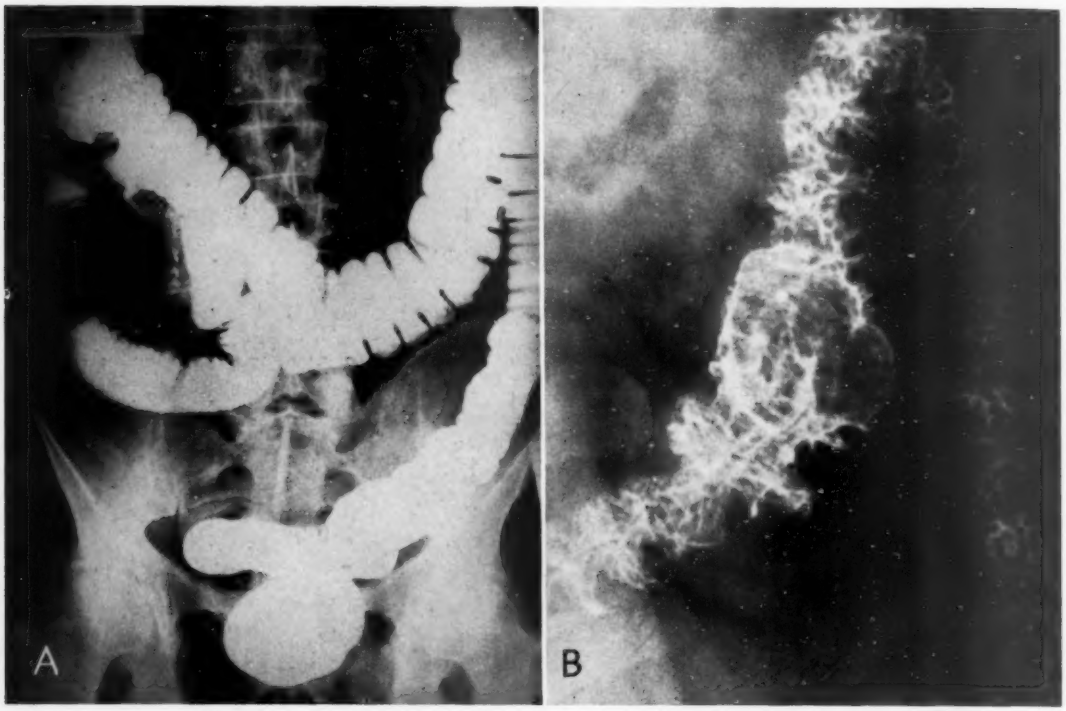

FIG. 2. Recurrent carcinoma at the site of the resected ascending colon. Benign pedunculated polyp of the transverse colon. (*A*) The small intestine is displaced by the mass of recurrent tumor. The polyp is obscured by barium when the colon is full. (*B*) Post-evacuation roentgenogram showing "bulge" of the contracted bowel due to the polyp within its lumen.

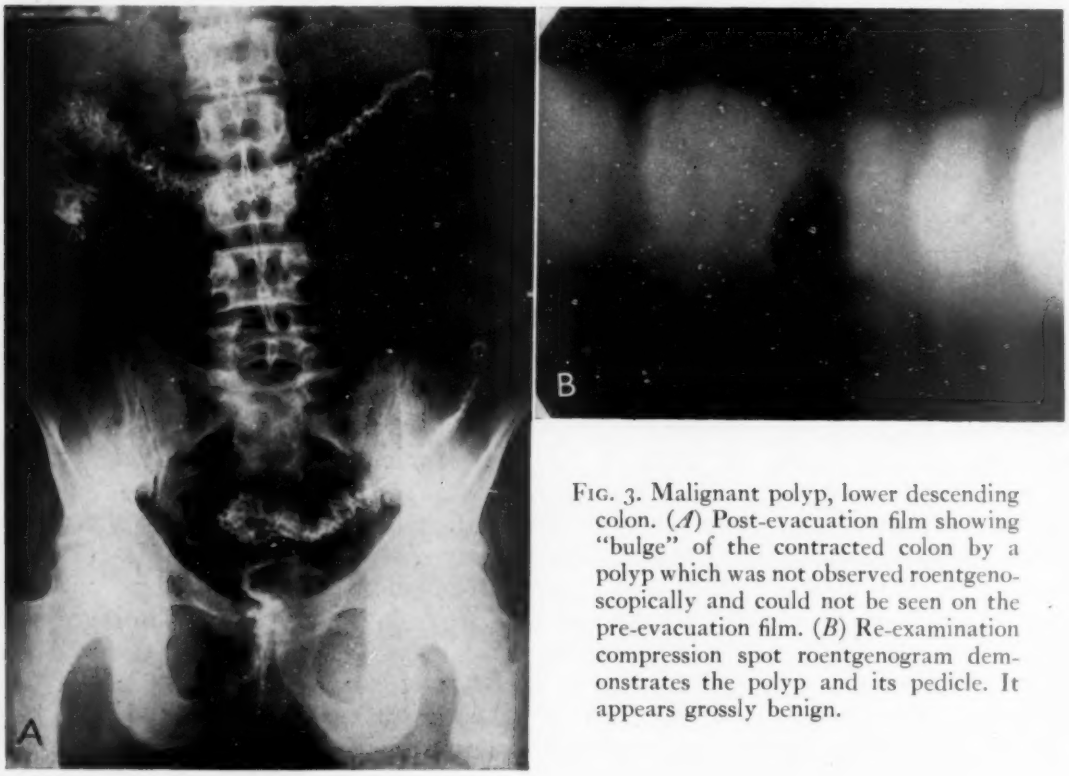

FIG. 3. Malignant polyp, lower descending colon. (*A*) Post-evacuation film showing "bulge" of the contracted colon by a polyp which was not observed roentgenoscopically and could not be seen on the pre-evacuation film. (*B*) Re-examination compression spot roentgenogram demonstrates the polyp and its pedicle. It appears grossly benign.

would be visible as a "bulge" (Fig. 2 and 3) of the contracted bowel, except where the gut is projected end on, especially in the lower sigmoid. It is sometimes necessary to administer pitressin to obtain complete contraction and it is occasionally necessary to double the concentration of tannic acid. Tannic acid has been used in over 4,000 examinations with no known unfavorable sequelae. Proctoscopic examination following the administration of tannic acid and water reveals no gross changes in the mucosa.[1] An occasional patient has fainted because of abdominal cramps produced by contraction of the bowel, but this is not considered an important contraindication to the use of tannic acid. Since the routine addition of tannic acid to the barium enema mixture and a more diligent search, the incidence of polyps in our clinic has increased markedly. Furthermore, we now feel more confident that the colon has been adequately examined.

Air contrast has failed in our experience to reveal the presence of any lesion which was not detectable by the means described above. It has, however, confirmed the nature of several lesions by demonstrating a polyp and its pedicle, coated with barium and surrounded by air instead of the negative density described in the literature.[5]

In the foregoing it can be seen that there is no such thing as a routine examination of the colon in the presence of rectal bleeding. There are various routine procedures, several of which may be carried out at the same examination, but a complete examination may entail the use of all available maneuvers on several separate occasions. Also there should be a frank discussion of the problem involved between the roentgenologist and the referring physician. For example, the barium may flow into the distal ileum and obscure the sigmoid portion of the colon, in which case the enema must be repeated with filling of the sigmoid and descending colon only. Frequently the fluoroscope will reveal no abnormality but on one or more of the films there will be a suggestive lesion (Fig. 3). *The patient*

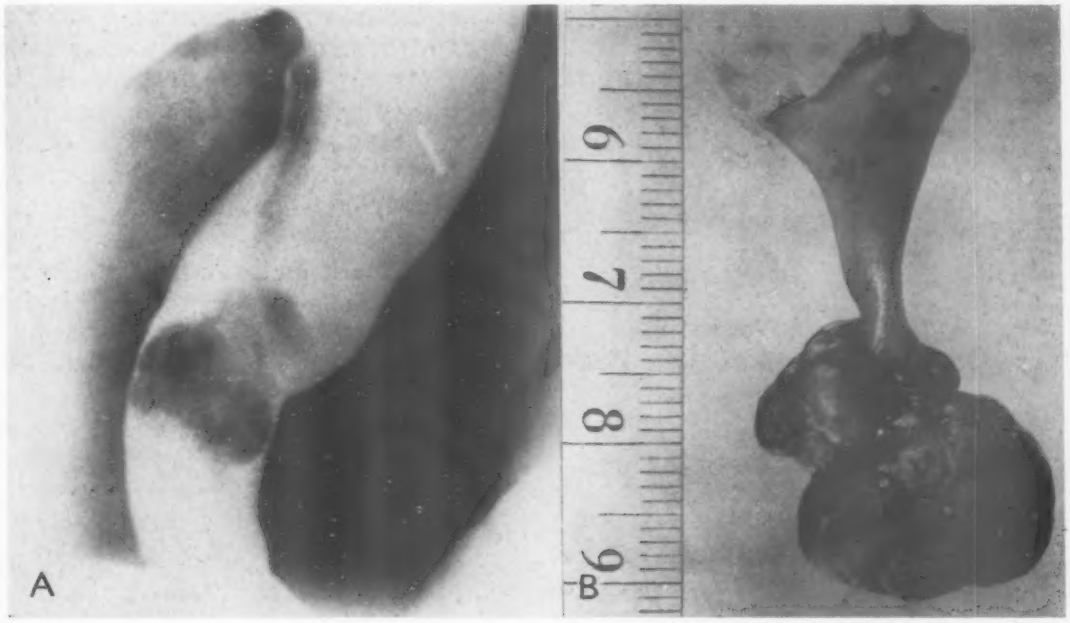

Fig. 4. Benign polyp, lower descending colon. (*A*) Conventional pre-evacuation roentgenogram. The polyp and its pedicle are clearly delineated. (*B*) The gross specimen conforms almost exactly to the filling defect demonstrated on the roentgenogram.

should then be recalled after another thorough preparation and re-examined with the focus of attention on the suspected segment and the use of all available maneuvers to thor oughly examine this segment. Wet film readings before the patient leaves will frequently allow this to be achieved at the one visit. Approximately 50 per cent of small lesions will fall into this category and would be overlooked if the radiologist should take the attitude that the colon is "probably all right."

FIG. 5. Benign polyp, sigmoid colon. This polyp could not be found at operation even after the bowel was opened. It was thought at operation to have been stripped from its pedicle by manipulation of the bowel and was later recovered in the patient's stool.

There have been many discussions and disagreements among roentgenologists regarding the relative importance of roentgenoscopy and roentgenography. It is now, however, quite generally accepted that a lesion which cannot be demonstrated on a film may be considered as not being present, and that the referring physician is well within his rights when he asks the roentgenologist to show him the evidence of the lesion. It is the roentgenologist's responsibility to thoroughly examine the colon, but it is also the responsibility of the referring physician to help him do so by confirming the necessity of re-examinations with the patient and by raising a question if there is any part of the bowel that is not demonstrated to his complete satisfaction.

A soft polyp cannot always be located by operative palpation of the bowel. This is particularly true if the polyp is attached by a long pedicle and slips back and forth under the surgeon's fingers. In 4 of the cases in this series, *the polyp was located only after the bowel was opened.* Such a polyp may be milked from its pedicle by too vigorous manipulation (Fig. 5). If a polyp has been clearly demonstrated roentgenologically the bowel should be opened in the location indicated. The colon changes length with contraction and relaxation, frequently making the roentgenological localization of the polyp difficult to correlate with the location at operation. It is helpful to have a sterile sigmoidoscope available in order to search a larger area of bowel through a single colon incision.

SUMMARY

1. Rectal bleeding, even as a single episode, may indicate the presence of a colonic polyp or carcinoma.

2. Every maneuver available to the roentgenologist should be utilized to demonstrate the cause of rectal bleeding. There must be repetition of the examinations until the origin of bleeding is demonstrated or the normal anatomy of the entire colon is shown.

3. The use of tannic acid (1 gram by weight to 100 cubic centimeters of barium-water suspension) has proved a valuable addition to the previous methods of examining the colon.

4. The examination of the colon as described above has revealed an incidence of forty polyps in 4,225 cases (1 per cent), and these polypi could not be diagnosed proctoscopically, except in two instances.

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DISCUSSION

Dr. Harry M. Weber, Rochester, Minn. This, in my opinion, is a very good paper and a stimulating one. The intestinal examination recommended by Dr. Wyatt and his associates is a good one in every respect. They begin their examination by insisting on having the patient prepared properly for their examination; this is a very elementary and fundamental prerequisite for a good examination. They fully appreciate the essential value of competent fluoroscopy. Experience has taught them—and I am very glad that they have emphasized this experience—that a single examination may not always be adequate and conclusive. By the word "examination" in this connection I mean the performance of all roentgenographic and roentgenoscopic maneuvers necessary to make the roentgenologic examiner confident about all evidence of abnormality he elicits, as well as about the complete lack of such evidence.

There was one statement in the paper with which I was provided to which I cannot subscribe, although I am willing to admit that it may be a matter of expression rather than a fundamental difference of opinion. The statement was this: "It is now quite generally accepted that a lesion which cannot be demonstrated on a film may be considered as not being present." If the word "cannot" is taken literally, then I perhaps would be willing to accept it, but I think it is often proper to make a diagnosis on the basis of roentgenoscopic evidence alone. Such evidence can be so convincing that it is hardly worth the time, effort, and expense involved to produce a roentgenographic demonstration of the lesion when, after all, our consultants must accept our interpretation of the roentgenographic evidence. I am assuming that there are physicians who by training and experience are not really competent to pass judgment on the significance of a given roentgenologic complex of signs.

I first had the use of tannic acid suggested to me by Leo Rigler. I do not recall just when it was but it was in the years between 1930 and 1935. I tried it on a representative series of patients at that time, and on several occasions after that. It does effect the changes on the mucous membrane of the intestine that Dr. Wyatt and his associates described. I do not recall the exact concentration of tannic acid that I used; it is possible that I did not use it in the same concentration that Dr. Wyatt and his associates have recommended. I observed that in some patients, at least, it seemed to effect a more complete expulsion of the contrast suspension that I considered to be ideal, and it also brought about the development of a richer and more permanent relief in many patients than was achieved without its use. In others, it effected no perceptible change whatever. I have had several minor objections to the use of tannic acid which I cannot discuss in detail at this time. The principal one has been that its action did not seem to be consistent to me. My associates and I have consistently failed to be convinced that the relief patterns we obtained with the use of tannic acid were more satisfactory for our purposes than those we obtained without its use. As everyone knows, the development of relief patterns of the intestinal mucous membrane is a complex phenomenon, dependent on a multitude of factors besides the physicochemical properties of our contrast fluids. I do not wish to leave the impression with you that I am completely satisfied with the relief patterns we obtain with our manner of conducting the intestinal examination. I can say, however, that the addition of tannic acid to our opaque enema did not achieve for us a more satisfactory intestinal examination, and I think that we have given it a fair

trial. I might suggest that the "more diligent search" may have contributed quite as much to the increased incidence of polyps in the clinic of Dr. Wyatt and his associates as the addition of tannic acid to their opaque enema did.

Those who are dissatisfied with the intestinal relief patterns they are obtaining will first convince themselves that tannic acid in the concentration recommended by Dr. Wyatt and his associates is safe for all classes of patients likely to be submitted to intestinal investigation. Having been convinced that it is safe, they will find it necessary to develop a new set of diagnostic criteria for the normal. In most patients tannic acid will effect a more complete expulsion of the opaque enema, and its astringent properties tend to produce a more pronounced relief than is observed without its use. In general, these effects are advantageous for the detection of polypoid lesions, but it must be remembered that there are other intestinal problems than the diagnosis of polypoid disease. I have good reasons to believe that too much stimulation of the motor activity of the intestine can obliterate the evidence of the early or mild forms of ulcerative intestinal disease.

I may go home and try tannic acid again in the concentration recommended by Dr. Wyatt and his associates. I strongly suspect, however, that I will not find its advantages to outweigh its disadvantages; I am willing to admit some prejudice in this matter, but my previous experience gives me very little reason to anticipate that the tannic acid opaque enema will become standard in our intestinal examination.

DR. COE (closing). I think one thing should be emphasized again because we have been asked so many times what is the concentration of tannic acid that we use. Dr. Wyatt stated 1 gram per 100 cc. of the mixture or 10 grams per liter of the solution. Smaller or larger concentrations might work. One individual has told me this morning that he used half that concentration. We have not found it satisfactory to use half concentration. If we increase the concentration too much, we get reactions. About 90 per cent of the lesions, or more, that we have found with this technique have been seen on the post-evacuation film, less than 10 per cent of them were seen on the enema as being filled.

I have also been asked the question several times this morning how small a lesion can be seen. I believe that any lesion 1 centimeter or larger should be seen on a post-evacuation tannic acid film. Those smaller than 1 centimeter, unless multiple, are not apt to be seen. The question arises as to the multiple polyps that we see: do we see those on our tannic acid post-evacuation film? Some of them may be too small to emerge from the shadow of the mucosa pattern, but if they are as large as a centimeter, they should be seen.

I am not going to enter into the general discussion that Dr. Weber has brought up about whether a lesion can be seen just as well fluoroscopically as on the films. I am a die-hard myself, and have maintained that many times I see things on the fluoroscope, that I knew they were there, and I could not demonstrate them on the film; but I am beginning to lean the other way and think that if there are proper spot films you should not be too sure of it unless you are able to show it on a film.

In regard to the point that Dr. Weber brought up, about obscuring pathological conditions other than polyps, he said he would rather have the colon undisturbed by this rather marked astringent. I think that is going to be one of the most interesting features of this study. We are going to be able to demonstrate certain lesions of the colon, functional and organic, by this mucosal pattern that we have never been able to demonstrate otherwise.

There is one thing that I want to mention and that is to be sure that your patients are cautioned to take sufficient time to fully evacuate the colon. That has been one of the problems in this unselected group. I am quite sure if we knew exactly, there were some of those that had not evacuated well, due to the fact that the patient had not taken time enough to fully evacuate the colon.

There was one other question about what type of tannic acid we used. We used any of the standard brands of the fluffy tannic acid. It is weighed as suggested. Then a mark is placed on a measure that shows the proper amount and from then on the technician, without packing it, puts that amount into a liter of the barium mixture.

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ROENTGENOGRAPHIC DEMONSTRATION OF ROKITANSKY-ASCHOFF SINUSES OF THE GALLBLADDER*

REPORT OF A CASE

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ROKITANSKY-ASCHOFF sinuses are outpouchings of the mucosa through the muscularis of the gallbladder wall. The roentgenographic visualization of these sinuses was first reported by March[2] in 1948. He reviewed the morphology of these sinuses and described a cholecystogram showing a "peculiar rim of dye passing in a layer concentrically around the gallbladder shadow" which proved to be dye within many Rokitansky-Aschoff sinuses in the gallbladder wall. It is thought that these sinuses represent herniations of the mucosa through interstices between the muscle bundles in the gallbladder wall. The muscularis of the healthy gallbladder is sufficiently dense to prevent such outpouchings. Thus, in healthy gallbladders, Rokitansky-Aschoff sinuses are rarely seen and if present at all they are shallow. When the gallbladder is pathologically involved the contractile elements are weakened and the intermuscular septa are widened. Then chronic overdistention of the viscus probably produces the herniations. Gallbladders which show Rokitansky-Aschoff sinuses are usually thickened due to inflammatory infiltration, connective tissue proliferation and edema. These are the changes of chronic cholecystitis.

Recently during the course of a cholecystographic study we encountered the unique picture which March believes is characteristic of visualization of the Rokitansky-Aschoff sinuses.

CASE REPORT

A white female, Mrs. A. H., aged fifty-six, was referred for cholecystography, May 1, 1948. The patient had been previously admitted to the hospital in 1944, at which time a grapefruit sized multilocular, papillary, serous cystadenoma of the left ovary was resected and a subtotal hysterectomy was done for multiple uterine fibroids. The postoperative recovery was uneventful. During the next four years the patient had periodic attacks of right upper quadrant pain, nausea, and emesis. There was no history of jaundice, dark urine, or light colored stools. Considerable distress followed ingestion of fatty foods. These attacks gradually increased in frequency and severity. On May 1, 1948, following one of these attacks (the patient was referred for a cholecystogram.

Physical Examination. Temperature, 99°F.; pulse, 88; respiration, 20; blood pressure, 100/50. The patient did not appear acutely ill. The abdomen revealed a well healed scar in the lower abdomen. There was slight generalized distention, but no tenderness. A walnut sized mass was palpable below the right costal margin.

Laboratory Findings. Urinalysis normal. Red blood cell count, 4,400,000 hemoglobin, 12.5 gm.; white blood cell count, 12,000; differential count normal. Glucose and urea normal.

Roentgen Findings. Cholecystogram after oral dye revealed a gallbladder shadow of slightly less than normal density. There was a constriction just below the gallbladder neck (Fig. 1 and 2) which was persistent both before and after the fat meal. Following the fat meal the gallbladder shadow contracted with complete emptying of the portion above the stricture while below the stricture there was some extravasation of the dye into the gallbladder wall forming a thin concentric ring of dye around the wall (Fig. 3). We concluded that we had demonstrated a stenosis near the neck of the gallbladder, chronic cholecystitis with visualization of the Rokitansky-Aschoff sinuses below the stricture.

Operation. June 5, 1948. Cholecystectomy—Through an upper right rectus incision, a thick

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FIG. 1. The shadow of the gallbladder is seen with a constriction just below the neck. This constriction was persistent on all projections.

FIG. 2. Oblique projection demonstrates the area of constriction with dye in its lumen. The upper sac is well outlined.

walled gallbladder was removed by subserosal dissection.

Surgical Pathology. The resected gallbladder measured 10 by 3 cm. The wall of the gallbladder was markedly edematous and thickened, measuring 0.5 cm. in thickness. At the fundus there were numerous match-head sized sinuses. The neck portion was narrowed and there were also pea sized diverticula in this area which were filled with pigmented stones (Fig. 4). In the lumen there were about six small cinder-like stones. A microscopic section through the gallbladder wall showed marked chronic fibrous cholecystitis. The unusual feature was

FIG. 3. After a fat meal, there is demonstrated complete emptying of the small upper pouch and the lower pouch is seen to change shape as though contracting. Note the thin rim of dye around the wall (dye within Rokitansky-Aschoff sinuses).

the presence of numerous Rokitansky-Aschoff sinuses, some of which were macroscopic in

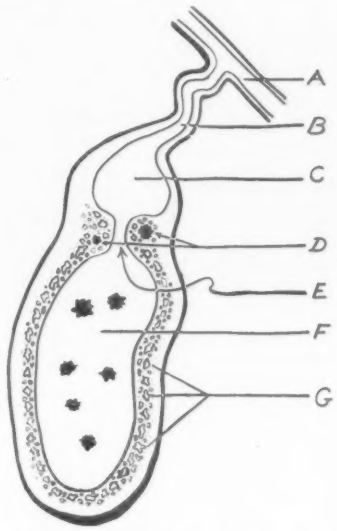

Fig. 4. Schematic drawing of gross pathological findings. *A*, common duct; *B*, cystic duct; *C*, upper pouch; *D*, pigmented concrements in the thickened wall in the region of the stricture; *E*, stricture of gallbladder; *F*, lower pouch containing few cinder-like stones; *G*, thickened wall containing macroscopic Rokitansky-Aschoff sinuses.

size and contained pigmented concrements (Fig. 5).

DISCUSSION

The rarity of roentgenographic visualization of Rokitansky-Aschoff sinuses as contrasted with the relative frequency of their occurrence in pathological specimens deserves comment. The usual association of these sinuses with marked chronic cholecystitis decreases the possibility of visualization of the gallbladder due to impairment of concentrating power. Halpert[1] believes that loosening and weakening of the contractile elements, widening of the intermuscular septa and overdistention of the viscus are the important factors in the production of Rokitansky-Aschoff sinuses.

The contractile power of the muscularis was most important in our case. We noted visualization of the sinuses only after a fat meal. March's case showed the sinuses before the fat meal but increased visualization was noted after the fat meal. In our

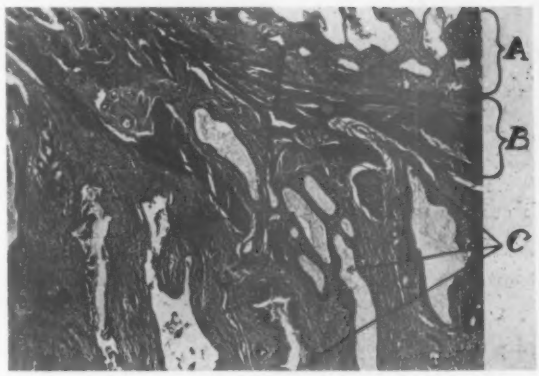

Fig. 5. Low power (×60) photomicrograph of microscopic section of gallbladder wall at the fundus, showing Rokitansky-Aschoff sinuses penetrating muscular layer and extending toward external layers. *A*, mucosa; *B*, muscular layer; *C*, Rokitansky-Aschoff sinuses.

case one must assume a weakening of the contractile elements occurred but sufficient contractile power was preserved to force dye into the sinuses. Perhaps in many cases the loss of contractile power is so great that no dye reaches the sinuses. It would seem that Rokitansky-Aschoff sinuses must be macroscopic for visualization during cholecystography. It is interesting to note that both our case and that of March showed a constriction of the gallbladder with sinuses only in that part of the gallbladder distal to the constriction. The constriction in March's case appeared congenital in origin while that in our case appeared to be a localized thickening of the wall at the neck of the gallbladder probably due to the presence of large macroscopic sinuses containing pigmented concrements. It appears that the stricture played a leading part in the production as well as the visualization of the sinuses in both cases.

SUMMARY

1. The roentgenographic appearance of dye within the Rokitansky-Aschoff sinuses of the gallbladder has been reviewed.

2. A case has been presented in which recognition of the typical roentgenographic appearance of filling of these sinuses during cholecystography enabled us to predict the pathological findings.

3. Factors accounting for the rarity of visualization of these sinuses are discussed.

We wish to express our appreciation to Dr. Mark A. Petrino for referring this case to us, also to Dr. Anthony Constantine of the Department of Pathology for his kind cooperation and valuable assistance in compiling the pathological findings.

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ROENTGEN PELVIMETRY BY DIFFERENTIAL DIVERGENT DISTORTION*

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ROENTGEN pelvimetry should be a simple technique yielding accurate pelvic measurements if it is to be suitable for universal application. An original method to be described for the measurement of the transverse diameters of the pelvis is easily carried out with no special equipment. It is believed to be equal or superior in accuracy to any of the commonly used systems of pelvimetry.

GENERAL PRINCIPLES

When an object parallel to a film is roentgenographed, the magnification of its image varies according to its distance from the film, provided the target-film distance is fixed. This principle is known as divergent distortion. It has been utilized in various methods of pelvimetry by making some provision for measuring or estimating the distance of the part to be measured from the film.

Conversely, if an object lying at an unknown but fixed distance from the film is roentgenographed, the degree of magnification depends upon variations in the target-film distance. By making two exposures at different known target-film distances, two distorted images of different size are produced. It will be shown that a mathematical relationship exists between the size of the two distorted images and the true size of the object. It is then possible to calculate the latter from the former *without knowing the distance of the object from the film.* The technique to be described depends upon this principle, which may appropriately be designated "differential divergent distortion."

The procedure involves taking two successive frontal films of the pelvis, shifting the tube from a target-film distance of 25 to 40 inches. The transverse diameter of the inlet and the interspinous diameter are measured with a millimeter ruler on both films. From each pair of measurements the actual diameter is calculated by applying a mathematical formula. A nomogram may be used to eliminate the mathematical operations.

ROENTGENOGRAPHIC TECHNIQUE

The patient is placed supine on the Potter-Bucky table. A thick pad is preferably placed under the lumbar spine, as advocated by Caldwell, Moloy and Swenson,[1] to obtain a truer projection of the pelvic inlet. The pad is not essential to the measurement procedure, however. The tube is centered over the pelvic inlet at a target-film distance of 25 inches and an exposure made on a 10 by 12 inch film. After raising the tube to the 40 inch distance, a second exposure is made on another film, multiplying the previous exposure time by 2.5.*

Before carrying out this procedure on any machine for the first time, the target-film distances indicated on the tube stand scale should be verified by measuring from the target point indicated on the tube housing to the screen surface of a cassette lying on the Potter-Bucky tray. If the distance scale is found to be inaccurate, correction indicators, such as adhesive strips, may be fixed to the scale at the true 25 and 40 inch distances.†

* If stereoscopic films are also desired, one may take a stereoscopic pair with horizontal tube shift at 25 inches. For the 40 inch film, the tube is then elevated from either of the 25 inch positions.

† For machines on which a true 40 inch target-film distance is not quite obtainable, use the maximum distance and take ⅛ of it for the near shift position. For example, 38 inches and 23¾ inches will give satisfactory results.

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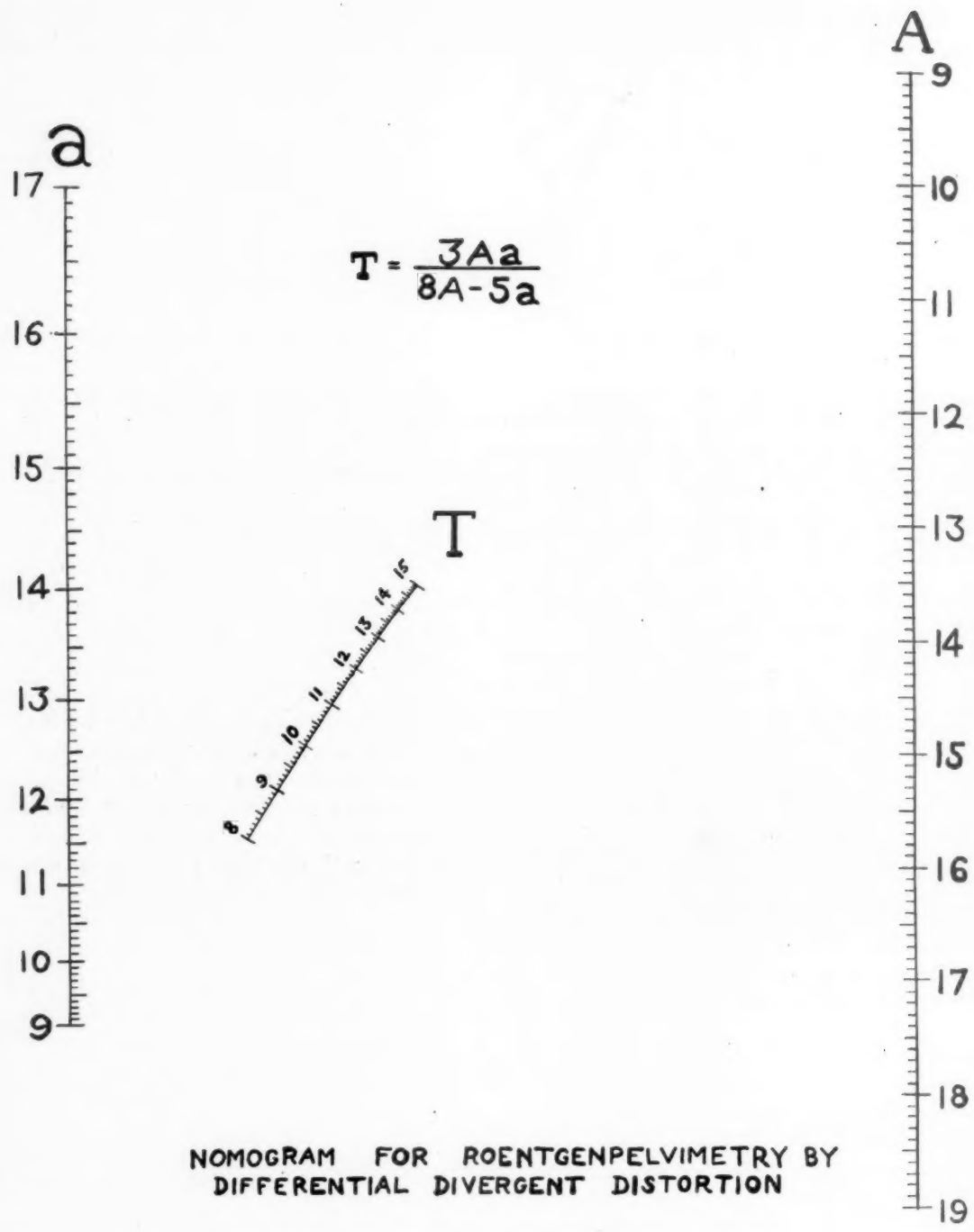

Fig. 1. Nomogram. Approximately two-thirds size of original.

This method is not recommended for sagittal plane measurements. In this hospital a single lateral view of the pelvis is routinely made with an isometric notched lead ruler placed between the buttocks, from which the true conjugate and other sagittal plane measurements are readily determined. A 45 degree tilt-up view of the subpubic arch completes the pelvimetric examination.

MEASUREMENT PROCEDURE

The widest transverse diameter of the pelvic inlet is measured with a ruler on each of the frontal films. The film taken at 25 inches yields the longer measurement, which will be referred to as "*A*." The shorter measurement, obtained from the 40 inch film is designated "*a*." To find the actual diameter, a ruler is laid across the nomogram (Fig. 1), so that its edge intersects the scales "*A*" and "*a*" at these measured lengths. The intersection of the ruler edge with the scale "*T*" then indicates the true length of the diameter. Similarly, measurements made between the images of the tips of the ischial spines are used to determine the actual interspinous diameter.

A representative pair of films taken with the lumbar spine hyperextended over a pad is shown in Figure 2. For comparison, a pair taken with the same patient in the ordinary supine position is shown in Figure 3. The lines of measurement have been drawn in on the films. The end points for measurement of the widest transverse diameter of the inlet and the interspinous diameter are usually obvious in either position. The true diameters derived are equally reliable regardless of which position is used, as will be shown later. The lumbar pad positioning is preferred, however, since the projected image more truly delineates the contour of the inlet. Furthermore, it has been found that the tips of the ischial spines, being projected well within the inlet, are more clearly seen than in the ordinary supine view, where they may sometimes overlie the superior pubic ramus. On a given pair of films taken in either position, the projection being the same, one is simply an enlargement of the other, and there is consequently no difficulty in establishing identical end points for measurement on the two films.

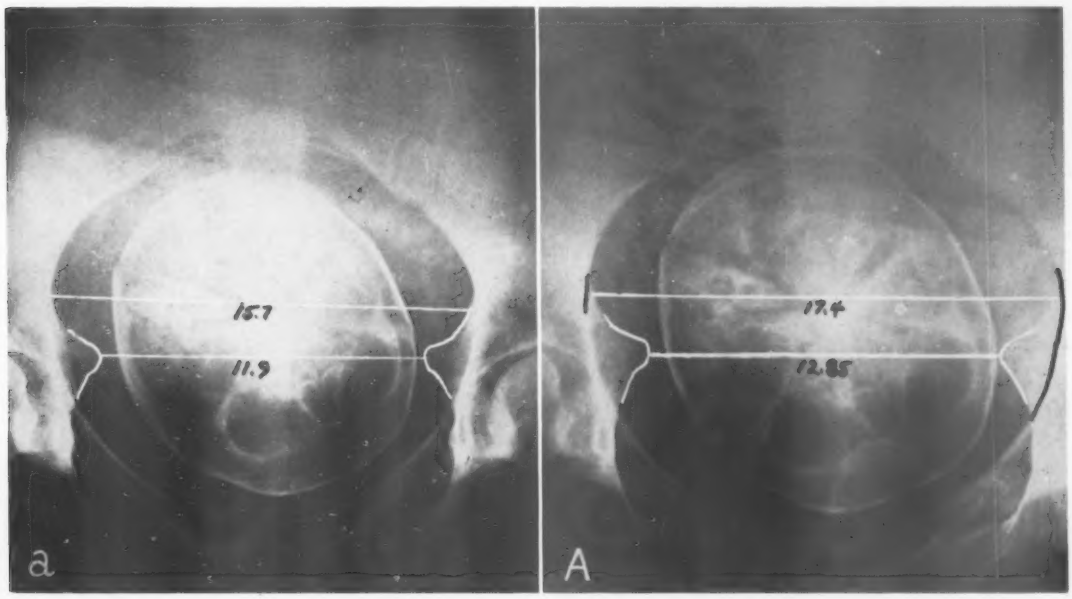

Fig. 2. Patient positioned with lumbar pad. Large gynecoid inlet. (*a*) 40 inch film. (*A*) 25 inch film. Calculated transverse diameter of inlet is 13.5 cm. and interspinous, 10.6 cm. (Line drawing added to show end points which are clearly seen on original roentgenogram.)

It is beyond the scope of this paper to enter into a discussion of the prognostic value in obstetrical practice of the precise measurement of these diameters. The fact that these measurements have been included in virtually all previous methods of roentgen pelvimetry is significant of their worth.

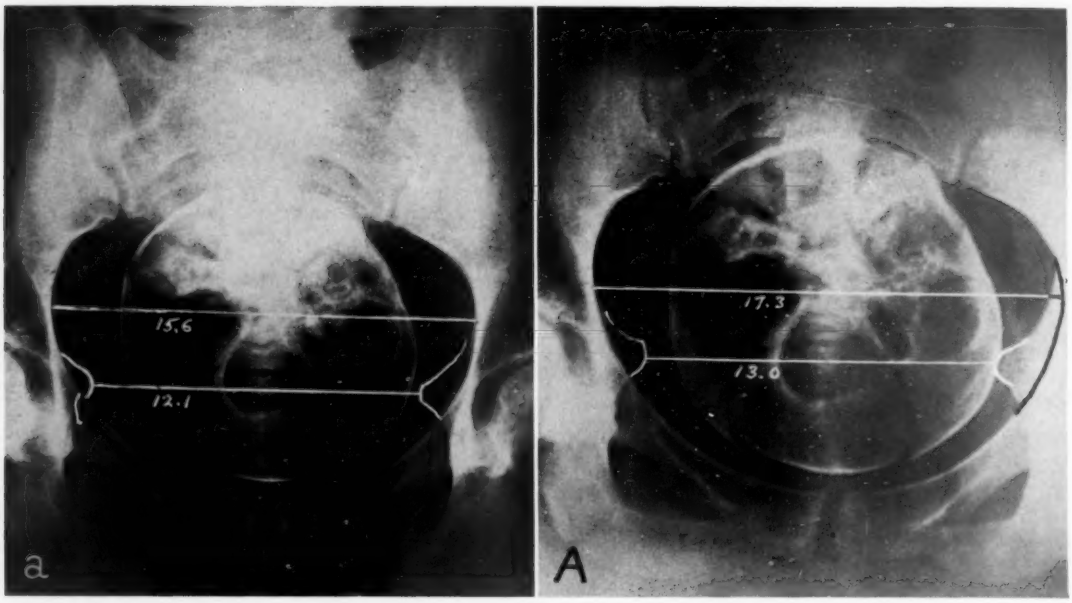

FIG. 3. Same patient as Figure 2. Supine position without lumbar pad. Note that inlet appears somewhat foreshortened. (*a*) 40 inch film. (*A*) 25 inch film. Calculated transverse diameter of inlet is 13.4 cm. and interspinous, 10.8 cm., closely agreeing with measurements obtained from Figure 2.

No attempt has been made to measure the bituberous diameter of the outlet by this method, although this would be possible theoretically. The end points for the ischial tuberosities are not considered to be definite enough to permit accuracy in measurement of the same high order that will presently be shown for the other diameters. Furthermore, the value of roentgeno graphic measurement of the bituberous diameter is rather doubtful, since direct measurement by the hand of the obstetrician is a perfectly practical method.

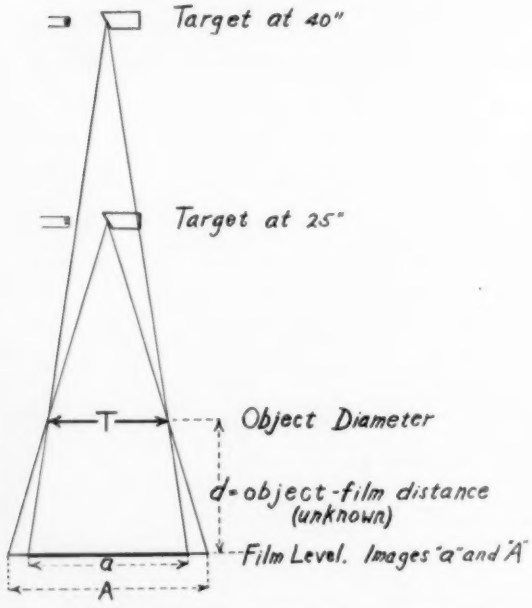

FIG. 4. Geometric figure involved in derivation of formula for differential divergent distortion.

DERIVATION OF THE CORRECTION FORMULA

The target-film distances of 25 and 40 inches were arbitrarily selected as standards for this method since it was believed that they represent the shortest and longest distances practically applicable to all patients and most roentgenographic machines. Another consideration was that the Caldwell-Moloy stereoscopic films were being taken at 25 inches and could be used in conjunction with the new method during its development. Any other pair of distances, reasonably far apart, could be used, but this would necessitate a change in the formula and the nomogram.

The relationship between "*a*," the 40 inch projection, and "*A*," the 25 inch projection, and "*T*," the actual diameter, is expressed by the equation:

$$T=\frac{3Aa}{8A-5a}.$$

Referring to Figure 4, the geometric figure involved, the above equation is derived by the following operations.

(1) $$T=\frac{A(25-d)}{25}.$$

(The equation for simple divergent distortion) (3)

(2) $$T=\frac{a(40-d)}{40}.$$

(The same equation for 40 inches)

(3) Therefore

$$\frac{A(25-d)}{25}=\frac{a(40-d)}{40}.$$

(4) This simplifies to $8A(25\text{-}d)=5a(40\text{-}d)$

(5) Solving for d:

$$d=\frac{200(a-A)}{5a-8A}.$$

(6) Substituting for d in equation (1):

$$T=\frac{A\left(25-\frac{200(a-A)}{5a-8A}\right)}{25}=\frac{3Aa}{8A-5a}.$$

CONSTRUCTION OF THE NOMOGRAM

To construct the nomogram, parallel straight lines were drawn of convenient length and separation, on which scales "A" and "a" were laid out as follows. Scale "A" was first divided into segments of equal length, each representing 1 millimeter. A convenient point between the parallel lines was then arbitrarily designated as a point of certain value for "T" (for example, $T=10$). Points of numerical value were than established along the "a" scale by laying a straight edge through the above point from various points on the predetermined "A" scale. The numerical value for the intersection of the straight edge with the "a" scale wa found by applying the equation $T=3Aa/(8A-5a)$, solved for A. With the scales "A" and "a" thus established, the "T" scale was then located. To do this, various pairs of "a" and "A" values corresponding to a given "T" value were used. The intersection of straight lines drawn between these pairs established the proper point for the corresponding "T" value. When sufficient "T" scale points were thus obtained, they were connected by a smooth curve, and the remaining millimeter divisions interpolated.

The nomogram covers values of "T" ranging from 8 to 15 cm. Since a diameter exceeding 15 cm. ordinarily poses no obstetrical problem, whereas one of less than 8 cm. generally indicates an absolute cephalopelvic disproportion, the range of the nomogram is adequate to encompass most useful measurements. In the event that extremes are encountered which fall beyond the numerical limits of any of the three nomogram scales, the equation may be used to determine the measurement sought.

EXPERIMENTAL DATA

Several experiments were carried out to test the validity of the theory of the method and to appraise its accuracy in application.*

(a) *Metal Objects.* One experiment involved the use of a pair of metal dividers, such as used by draftsmen, the points being spread to represent a diameter for measurement. The dividers were supported at random distances above the roentgenographic table so that an imaginary line between their points lay parallel and transverse to the table top and was bisected by the central ray. Exposures were made at the 25 and 40 inch target-film distances and the distance between the points was calculated from the film measurements. Close agreement was obtained with the actual measurement (Table 1).

In a similar experiment, the object was

* In these experiments, measurements on the films were estimated to tenths of millimeters and the calculations carried out mathematically. The calculations were checked with the nomogram, from which a result correct to the nearest millimeter could invariably be obtained.

TABLE I

EXPERIMENTAL DATA ON METALLIC OBJECTS

Type of Object	Position of Object Diameter (parallel to table and transverse on table in all tests)			A	a	T Calculated Diameter	Actual Measure	Error
	Off center laterally	Off center longitudinally	Unknown distance from film					
	inches	inches		cm.	cm.	cm.	cm.	mm.
Dividers (between tips)	0	0	d_1	18.50	15.95	12.97	13.00	−0.3
			d_1	13.75	12.05	9.99	10.00	−0.1
			d_2	16.50	15.00	13.03	13.00	+0.3
			d_2	11.75	11.00	9.94	10.00	−0.6
Perforated lead strip (between holes)	1	0	d_3	16.87	15.15	12.95	13.00	−0.5
		3	d_3	16.87	15.15	12.95	13.00	−0.5
		0	d_4	15.03	14.20	13.00	13.00	0.0
		3	d_4	15.04	14.20	12.99	13.00	−0.1

TABLE II

EXPERIMENTAL DATA ON DRIED PELVES AND CADAVER

Specimen	Positioning	Unknown Distance from Film	Diameter Measured	A	a	T Calculated Diameter	Actual Measure	Error
				cm.	cm.	cm.	cm.	mm.
Dried pelvis No. 1	Simulated lumbar pad	d_5	Trans. inlet	16.35	14.65	12.49	12.55	−0.6
			Interspinous	12.65	11.85	10.72	10.80	−0.8
		d_6	Trans. inlet	17.55	15.30	12.60	12.55	+0.5
			Interspinous	13.55	12.35	10.76	10.80	−0.4
	Simulated supine	d_7	Trans. inlet	17.00	15.05	12.63	12.55	+0.8
			Interspinous	13.35	12.25	10.75	10.80	−0.5
		d_8	Trans. inlet	16.30	14.60	12.44	12.55	−1.1
			Interspinous	12.85	11.95	10.70	10.80	−1.0
Dried pelvis No. 2	Simulated lumbar pad	d_9	Trans. inlet	16.85	15.40	13.47	13.40	+0.7
			Interspinous	11.20	10.55	9.62	9.75	−1.3
		d_{10}	Trans. inlet	18.15	16.05	13.49	13.40	+0.9
			Interspinous	11.95	11.00	9.71	9.75	−0.4
	Simulated supine	d_{11}	Trans. inlet	17.90	15.90	13.40	13.40	0.0
			Interspinous	12.00	11.00	9.66	9.75	−0.9
		d_{12}	Trans. inlet	18.80	16.35	13.43	13.40	+0.3
			Interspinous	12.50	11.20	9.55	9.75	−2.0
Cadaver	Lumbar pad	natural	Trans. inlet	17.10	15.30	13.02	13.05	−0.3
	Supine	natural	Trans. inlet	16.60	15.10	13.12	13.05	+0.7

a thin lead strip in which pinpoint perforations had been made at measured intervals. The simulated pelvic diameter (between two perforations) was intentionally decentered 1 inch laterally from the midline of the table, as might occur in the case of an imperfectly centered patient. Other tests simulated the positioning fault of a focal spot being centered caudad or cephalad to the diameter being measured by as much as 3 inches. No appreciable error was introduced by decentering in either the lateral or longitudinal direction.

These experimental results (Table 1) reveal that in no case did the calculated distance vary from the actual distance by more than 0.6 mm.

(b) *Dried Pelves.* The differential divergent distortion method was applied to two dried pelves. These were supported at random distances from the table top in positions simulating either the frontal supine view of the obstetrical patient or the projection produced with a lumbar pad, in which the plane of the inlet is more nearly parallel with the table top. The data presented in Table II reveal the accuracy of the calculated diameters. In eight tests, the maximum error for the transverse diameter of the inlet was 1.1 mm. and for the interspinous diameter, 2.0 mm.

(c) *Cadaver.* One female cadaver was available for roentgen pelvimetry prior to necropsy. Films were taken in both the supine and the lumbar pad positions. The transverse diameter of the inlet was calculated as 13.12 and 13.02 cm. in the two positions respectively, and subsequent actual measurement was 13.05 cm. At that time the procedure was being considered only in its possible application to inlet measurements, so that the interspinous diameter was unfortunately not checked at necropsy.

COMMENT

Differential divergent distortion is not a modification of any pre-existing method of roentgen pelvimetry. Hodges and Dippel[3] classified all techniques described before 1940 into four general divisions, namely "position," "parallax," "90 degree triangulation," and "orthometric reproduction" methods. None of these principles is utilized in the technique that has been described. Vertical tube shift methods have previously been devised by Portes and Blanche[1] and Christensen.[2] Both employed a decentered tube and derived their results by geometric constructions on the two roentgen-ray images, thus differing considerably from the present method.

In developing this technique it was felt that it had certain inherent advantages over other methods. Otherwise no worthwhile purpose would be served by adding it to the multitude of pelvimetric methods which have been described. Both the roentgenographic technique and the measurement procedure on the films are so simple that the method may be employed by any radiologist with a minimum of time and effort. No equipment is required other than a roentgenographic table, an ordinary millimeter ruler, and a nomogram for which simple mathematics may be substituted. Any technician can take the required films without special training since the positioning is extremely easy and requires no measurements to be made on the patient's body. Hodges and Dippel[3] in their critical appraisal of pelvimetric methods, significantly observe in this regard that, "as a rule pelvimetry should be based on x-ray images and should be independent of body measurements." The present method embodies the advantages of the parallax principle, which they favor because of its complete objectivity and fixed roentgenographic factors. The parallax methods require an exact horizontal tube shift within a range of a few inches. It would seem reasonable that with ordinary roentgenographic equipment a vertical shift from the 25 to the 40 inch level may be performed with relatively greater precision. A further consideration is that parallax methods generally require more effort and skill in arriving at measurements than does the differential divergent distortion method.

The additional advantage of being able to make measurements from wet films is also of importance when dealing with patients in labor.

In evaluating an obstetrical problem, the roentgenograms taken provide further important information in addition to the measurements obtained. When the lumbar pad is used, a reasonably good projection of the pelvic inlet is obtained, which aids in the determination of the morphological type of the pelvis. If stereoscopy is desired, an additional film may be taken for this purpose with horizontal shift.

The possible application of this method to fetal cephalometry has been considered, but awaits further experimentation. The fact that the method requires no estimation of the object-film distance may favorably influence its potential usefulness in this field.

SUMMARY

An original method for roentgen pelvimetry is described, applicable to the measurement of the transverse diameter of the pelvic inlet and the interspinous diameter. A pair of frontal roentgenograms is taken with a vertical tube shift employing target-film distances of 25 and 40 inches. From the diameters measured on the roentgenograms, the actual diameter is calculated mathematically. The calculations may be made mechanically by employing a nomogram the construction of which is described.

Experimental evidence is presented to demonstrate the accuracy of the method. Because of its simplicity, objectivity, and accuracy, and since no special equipment is required, the method is believed to compare favorably with other methods for general use in roentgen pelvimetry.

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ACCURATE ISOMETRIC ROENTGEN PELVIMETRY IN THE ERECT POSTURE

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SINCE it is conceded by most that in roentgen pelvimetry an erect lateral view is more desirable than a recumbent one in that the fetal head becomes somewhat lower in relationship to the inlet or pelvic canal, a simple accurate method was devised of applying isometric pelvimetry entirely in the erect posture.

The simple device needed (Fig. 1) consists of an upright support about 5 feet high to which are clamped two aluminum plates and a perforated metal centimeter rule, all adjustable on the upright. The aluminum plates serve as contact points for the patient's shoulders and buttocks, respectively, in the lateral view, and are in the same vertical plane. The perforated rule extends horizontally, and the zero of the scale is at the vertical plane of the two plates. Every fifth centimeter mark is identified by progressively multiple perforations (2 holes at the 5 cm. mark, 3 at the 10, etc.). The erect lateral film is taken first, the purpose of the plates being to reproduce the same pelvic tilt that is present in the anteroposterior projection when the patient stands with her buttocks and shoulders touching the vertical roentgen table. The second purpose is to serve as the spatial representative of the table top, i.e., base-line, in the lateral view, so that distances of transverse diameters of the pelvis from the table top can be accurately determined in the lateral view. The base-line need not appear on the film, however, since the centimeter rule directly records the distance from the base-line of any point in the lateral view by merely dropping a vertical line from that point to where it intersects the image of the rule.

The rule is elevated as high as possible between the thighs of the patient through the back-opening gown. The film is placed so that the image of the rule will appear at the bottom of the film. The patient's arms are folded across her chest. After the lateral view is taken, the device is removed, the patient slowly turned so that her shoulders and buttocks touch the table top, and the anteroposterior projection made with the Potter-Bucky tray at the same position as previously.

These two films (Fig. 2) may be all that

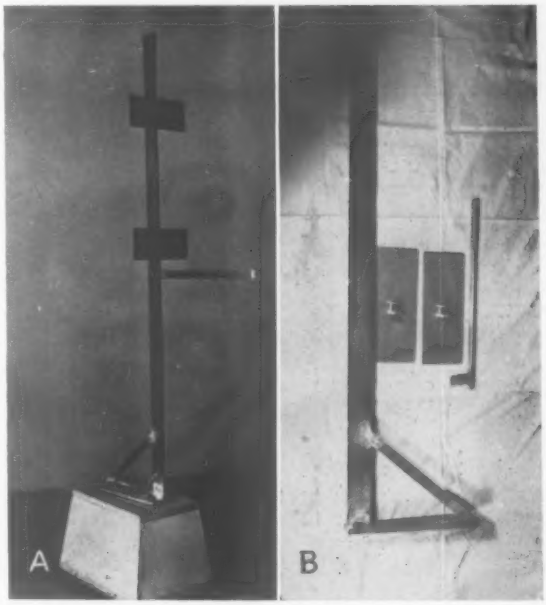

FIG. 1. (*A*) View of device assembled. (*B*) Device disassembled into its component parts.

is necessary for complete accurate pelvimetry if the pelvic inclination is such that a fairly adequate qualitative concept of the inlet can be obtained from the anteroposterior projection. If not, an additional superoinferior projection of the inlet on a 10 by 12 inch film is made in the semi-sitting posture. The author takes this routinely, as it more accurately localizes the relative anteroposterior position of the greatest transverse diameter of the inlet.

All of the anteroposterior diameters of

the various pelvic planes can now be read directly from the lateral film by laying off the length of the given diameter on the image of the centimeter scale, which lies in the patient's mid-sagittal plane. This, of course, is common practice in a number of recumbent techniques of pelvimetry. Any transverse diameter of the pelvis can also be readily obtained. First, the distance of the diameter from the table top is obtained from the lateral view directly from the centimeter scale as mentioned above. Its length on the anteroposterior view is then laid off at this distance on a projection centimeter scale (Fig. 3). This scale is simplified from that of Walton[8] in that the various levels are numbered to correspond to the distance from the table top rather than from the film, since the film-table top distance is constant, and one thereby obviates the necessity of adding this factor each time in determining the distances of given diameters from the film. The scale is based on the usual proportion expressing the relationship of corresponding sides of two similar right angle triangles, and is constructed so that any given centimeter level incorporates the table top-film distance (thus the 7 cm. level actually represents 12 cm. from the film, the table top-film distance in the author's table being 5 cm.).

Cephalometry is done either from the long and short diameters of the fetal skull or from its circumference, either or both of these dimensions being obtained from each view and averaged. Accuracy is obtained only when the skull is in the midline or very close to it. The method can be used for breech presentation also, provided that the lateral view will encompass both the centimeter scale and the fetal head, and provided the head is in the midline.

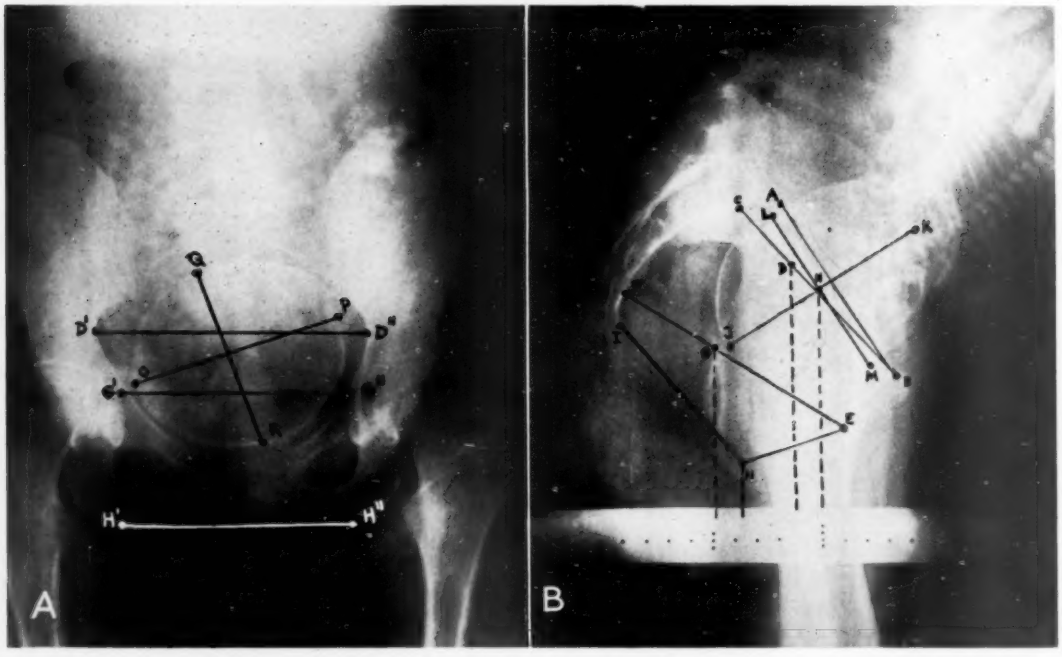

FIG. 2. Erect anteroposterior (*A*) and lateral (*B*) films, showing image of the centimeter rule in the lateral view. The various diameters and distances readily obtainable have been drawn on the roentgenograms for illustrative purposes, but are not ordinarily recorded on the films.

DISCUSSION

The isometric method of pelvimetry has been mentioned by Walton[8] and Snow[6], and described by Steele,[7] Javert,[4] McLane,[5] Henderson,[3] and Wilson[9] with various tech-

niques for the recumbent posture. Ball and Golden[1] and Borman[2] have applied it to the erect posture, but Ball's method depends on an arbitrary approximation of the base-line, which has been demonstrated by my method to be 2 to 3 cm. off at times. Borman's method is more accurate but more complex and inconvenient than the present one. Neither Ball nor Borman's method attempts to maintain the same pelvic inclination in both projections.

The advantages of my method are: (1) The device is simple and the technique is simple. (2) Only two or three films are generally needed. (3) Accurate measurement of the anteroposterior and transverse diameters of the pelvic inlet, midplane, and outlet are readily obtained. (4) Since the entire examination is conducted in the erect posture, the benefit believed to be derived from this posture in having gravity aid the deeper placement of the fetal head in the pelvis is inherent in this procedure. (5) Accurate fetal cephalometry is possible when the skull is in or close to the midline.

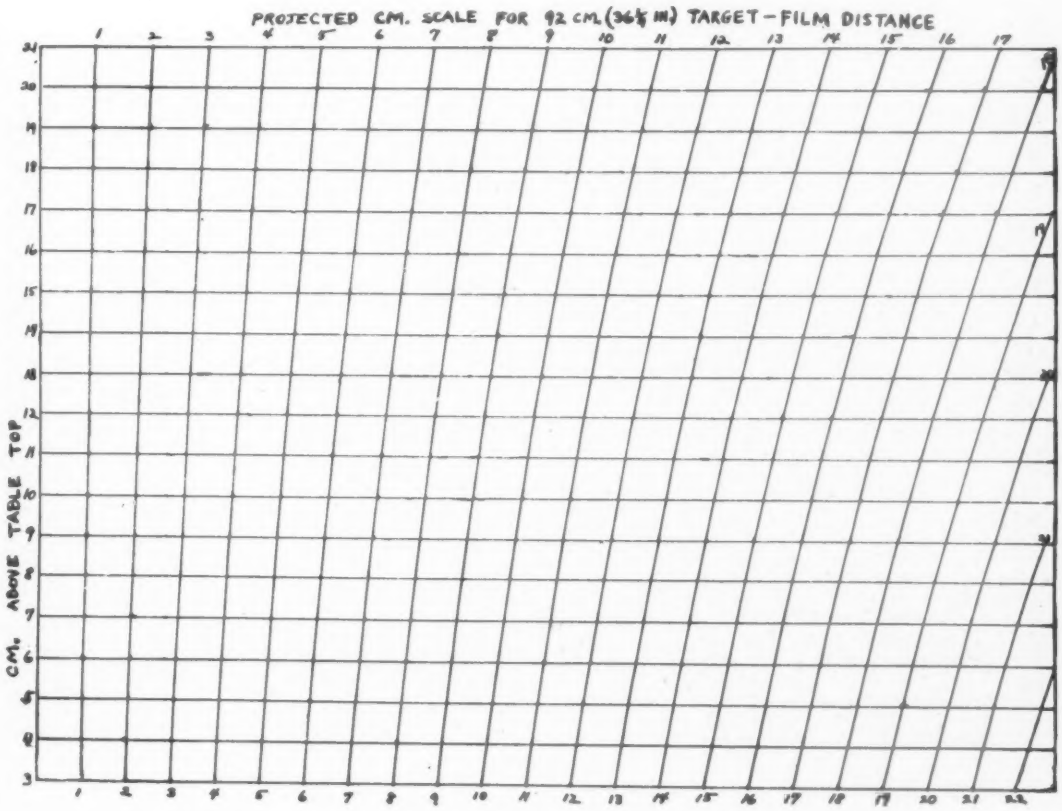

Fig. 3. Projected centimeter scale, simplified from Walton, as explained in the text.

(6) The method is applicable to practically all pre-labor pregnant women and a considerable proportion of women in labor.

The disadvantages of this method are: (1) It is not applicable to women who cannot stand, either by reason of considerable bleeding or because of exhaustion from labor or heavy sedation. (2) Greater exposure is required for the anteroposterior projection in the erect posture than when the patient is recumbent. (3) In the anteroposterior projection there is less sharpness of detail and contrast of the fetal parts, particularly those in the forward and upper portion of the uterus. (4) In the lateral

projection the uterine fundus tends to fall forward more in the erect posture than in the recumbent, so that less of the upper fetal parts and uterine fundus may be included on the film.

SUMMARY

1. A method of isometric roentgen pelvimetry in the erect posture is presented.
2. A simple device to permit this to be an accurate procedure is described.
3. The advantages and disadvantages of the method are considered.

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ROENTGEN IRRADIATION OF DESOXYRIBOSENUCLEIC ACID

I. MECHANISM OF THE ACTION OF IRRADIATION IN AQUEOUS SOLUTION*

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THE mechanism of the action of roentgen radiation in the destruction of cells is not understood. Disturbances of nucleic acid metabolism produced by roentgen irradiation have been found by several workers.[10,17] An explanation of the mechanism of the roentgen irradiation of nucleic acid in aqueous solution is therefore a primary consideration.

Depolymerization of desoxyribosenucleic acid (DNA) in aqueous solution by roentgen irradiation was found by Taylor *et al.*[19] to be inhibited by the presence of egg albumin. It was stated by them that the mechanism of this action may be indirect. The primary mechanism of the action of roentgen irradiation of aqueous solutions of biologically active substances as well as many organic and inorganic compounds is now generally considered to be indirect, mediated through the production of free radicals (OH, H, etc.) from the medium. Correlation between the protective ability of added substances and their chemical structure has been shown by Dale.[8] For example, thiourea was found to be a much better protective agent than urea.

Direct evidence in support of the free radical mechanism for the roentgen irradiation of aqueous solutions was obtained by Dainton[7] by the polymerization of acrylonitrile in aqueous solution by chemically generated free radicals as well as by roentgen and gamma radiations. Recent experiments by Scholes *et al.*[18] have shown that the roentgen irradiation of aqueous solutions of nucleic acid with very large doses produced changes in the nucleic acid similar to those produced by free radicals generated by the reduction of hydrogen peroxide by ferrous ions.

DNA in this investigation was found to be depolymerized in aqueous solution by chemically generated free radicals as well as by roentgen irradiation and thiourea was found to inhibit depolymerization by both means. Additional evidence for the indirect mechanism was obtained by the inability to depolymerize DNA in a dry state, in ethylene glycol, or in a frozen aqueous solution, by roentgen irradiation.

MATERIALS AND METHODS

The DNA was prepared from calf thymus by the Mirsky-Pollister procedure[16] which utilizes the difference in the solubilities of RNA and DNA in physiological saline solution and the deproteinization with chloroform. Three samples of DNA prepared by this method were used. Sample No. 1 had a N/P ratio of 1.96 and a final pH 8.5. Sample No. 2 had a N/P ratio of 1.665 and a final pH 6.2. Sample No. 3 had a N/P ratio of 1.84. Three solutions were prepared from these samples and exhibited intense streaming birefringence and structural viscosity and were stable for over six months. The extent of the depolymerization was determined by the measurement of the structural viscosity, streaming birefringence, and the sedimentation constants of the DNA solutions.

A Bingham-Jackson[5] type viscometer with a capillary radius of 0.0565 cm. was used to measure relative viscosities under varying external pressures at 30° C. The pressure system was similar to the one described by Bingham.[4] The pressures used varied from 10 to 80 mm. mercury. Concentrations of about 0.2 per cent DNA were found to be the most convenient. Following Edsall and Mehl,[9] the relative viscosities were plotted against the mean velocity

* Results presented in this paper were a part of the thesis presented by George Limperos to the Chemistry Department of the University of Delaware in partial fulfillment of the requirements for the Degree of Doctor of Philosophy, September, 1949.

gradient, β, where $\beta = 8V/3r^2t$ and the values of ν_∞ were obtained by extrapolating the curves to high values of β and substituting in the relation $\nu_\infty = (\eta_{sp}/c\alpha)_{\beta\to\infty}$, where c is the concentration in g. per 100 g. of solution and α is the partial specific volume. A partial specific volume of 0.53 was found by using the falling drop method[2] for determining the densities.

The micro apparatus used to determine the relative changes in the streaming birefringence of the DNA solutions was very similar to the one devised by Lauffer and Stanley.[11] A photoelectric circuit developed by Enns[11] was used in place of the photoelectric system described by Lauffer and Stanley. A microammeter as well as a galvanometer with each division equivalent to 0.0167 μa were used.

A roentgen-ray machine operating at 120 kv. constant potential and 15 ma. was used in irradiating all DNA solutions at a rate of 1,700 roentgens per minute. DNA solutions of 10 ml. each were irradiated in Petri dishes 9 cm. in diameter covered with a sheet of duraluminum 0.001 inch thick.

RESULTS

Comparison of the Effects of Chemical Free Radicals and Roentgen Irradiation. The data obtained from experiments on the effects of the chemical free radicals and roentgen irradiation are summarized in Table 1. Solution No. 2 was found to be unaffected by H_2O_2 up to a concentration of 10^{-2} M (Fig. 1) as had been found by Taylor *et al.*[19] The DNA solutions gelled rapidly when ferrous chloride, cuprous chloride, or copper sulfate was added in concentration of 1 per cent or greater.

Chemically produced free radicals depolymerized DNA solutions as readily as roentgen irradiation. Depolymerization continued spontaneously after initiation by roentgen irradiation or by chemical means (Fig. 2). This was similar to the spontaneous depolymerization found by Taylor *et al.*[19] after roentgen irradiation. Free radicals generated by the reduction of hydro-

TABLE I

EFFECT OF FREE RADICAL REAGENTS AND ROENTGEN IRRADIATION ON DNA SOLUTION NO. 2. (0.196%) N/P = 1.665

Reagents	Time hr.	Streaming Birefringence, mm.	ν_∞	Sedimentation				
				Sedimentation constants		Viscosity correction factors		
				Uncorrected	Corrected for viscosity			
				S	Solv. S	Soln. S	Solv.	Soln.
Control	—	480	980	3.58	3.05	37.30	0.861	10.41
Roentgen rays 50,000 r (1710 r/min.)	24	240	687	4.02	3.25	18.20	0.808	4.53
Control (0.262% DNA)	—	480	734	—	—	—	—	—
Roentgen rays 100,000 r (1710 r/min., 0.262%)	24	150	361	—	—	—	—	—
10^{-1} M thiourea + 100,000 r (1710 r/min., 0.262% DNA)	24	480	734	—	—	—	—	—
10^{-1} M H_2O_2	48	0	491	3.27	2.77	3.86	0.847	1.178
10^{-1} M thiourea + 10^{-1} M H_2O_2	$\frac{1}{4}$	0	224	5.65	4.81	5.30	0.851	0.939
1 M thiourea + 10^{-1} M H_2O_2	$\frac{1}{4}$	0	294	—	—	—	—	—
10^{-2} M H_2O_2	24	480	980	—	—	—	—	—
10^{-4} M $FeSO_4$	24	480	980	—	—	—	—	—
10^{-4} M $FeSO_4$ + 10^{-2} M H_2O_2	$\frac{1}{2}$	20	294	2.08	1.65	1.66	0.795	0.798
10^{-4} M $FeSO_4$ + 10^{-3} M H_2O_2	$\frac{1}{4}$	15	294	—	—	—	—	—
10^{-4} M $FeSO_4$ + 10^{-4} M H_2O_2	24	180	785	—	—	—	—	—
10^{-1} M thiourea + 10^{-4} M $FeSO_4$ + 10^{-2} M H_2O_2	$\frac{1}{2}$	40	589	—	—	—	—	—
10^{-1} M thiourea + 10^{-4} M $FeSO_4$ + 10^{-3} M H_2O_2	48	40	637	—	—	—	—	—
10^{-3} M $K_2S_2O_8$	48	0	147	6.13	5.09	5.80	0.831	0.946
10^{-1} M thiourea + 10^{-3} M $K_2S_2O_8$	$\frac{1}{4}$	40	98	8.36	6.97	7.55	0.835	0.901
10^{-3} M ascorbic acid	$\frac{1}{4}$	10	490	2.29	1.87	1.93	0.816	0.866
10^{-1} M thiourea + 10^{-3} M ascorbic acid	3	35	785	—	—	—	—	—
10^{-3} M $NaBO_3$	48	30	785	4.59	3.77	11.60	0.820	2.52
10^{-1} M thiourea + 10^{-3} M $NaBO_3$	48	300	980	—	—	—	—	—

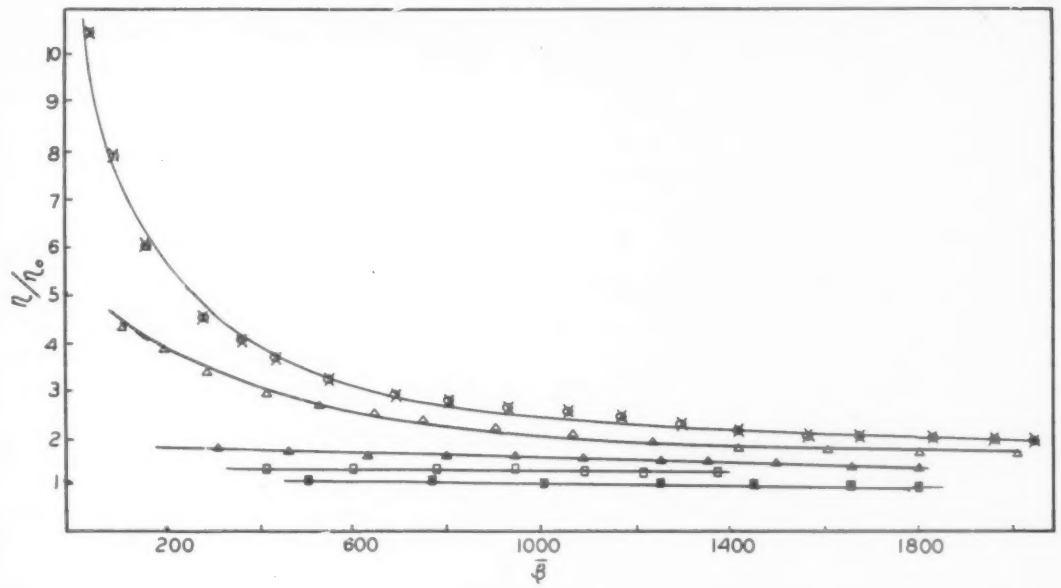

FIG. 1. Effect of H_2O_2 and thiourea on structural viscosity of DNA solution No. 2 (0.196%). ○ Control; △ 10^{-1} M H_2O_2 20 hr.; ▲ 10^{-1} M H_2O_2 48 hr.; × 10^{-2} M H_2O_2 20 hours; □ 10^{-1} M H_2O_2+10^{-2} M thiourea 15 min.; ■ 10^{-1} M H_2O_2+10^{-1} M thiourea 15 min.

gen peroxide by ferrous ions in concentrations as low as 10^{-4} M and 10^{-5} M respectively were sufficient to depolymerize DNA solutions. Thiourea in a concentration of 10^{-1} M acted as an inhibitor when added before ferrous ions and hydrogen peroxide (Fig. 3). When thiourea was used with H_2O_2 alone, however, depolymerization took place more rapidly than with H_2O_2 alone (Fig. 1). Thiourea inhibited depolymerization by roentgen irradiation even when doses as high as 100,000 r were used (Table 1).

Ascorbic acid (10^{-3} M) was a good de-

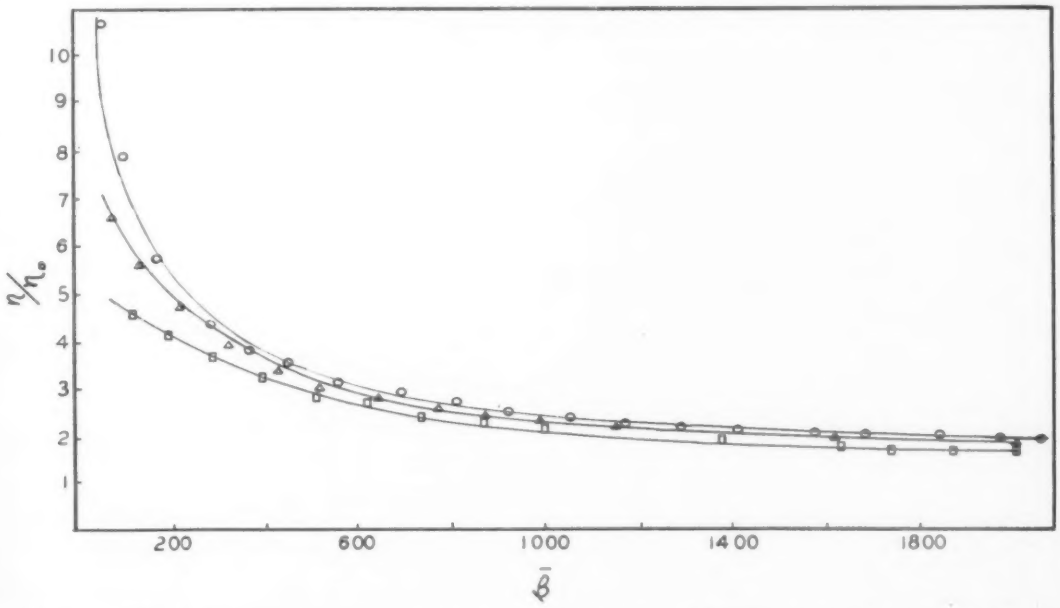

FIG. 2. Effect of roentgen irradiation on structural viscosity of DNA solution No. 2 (0.196%). ○ Control; △ 50,000 r 5 hr.; □ 50,000 r 24 hr.

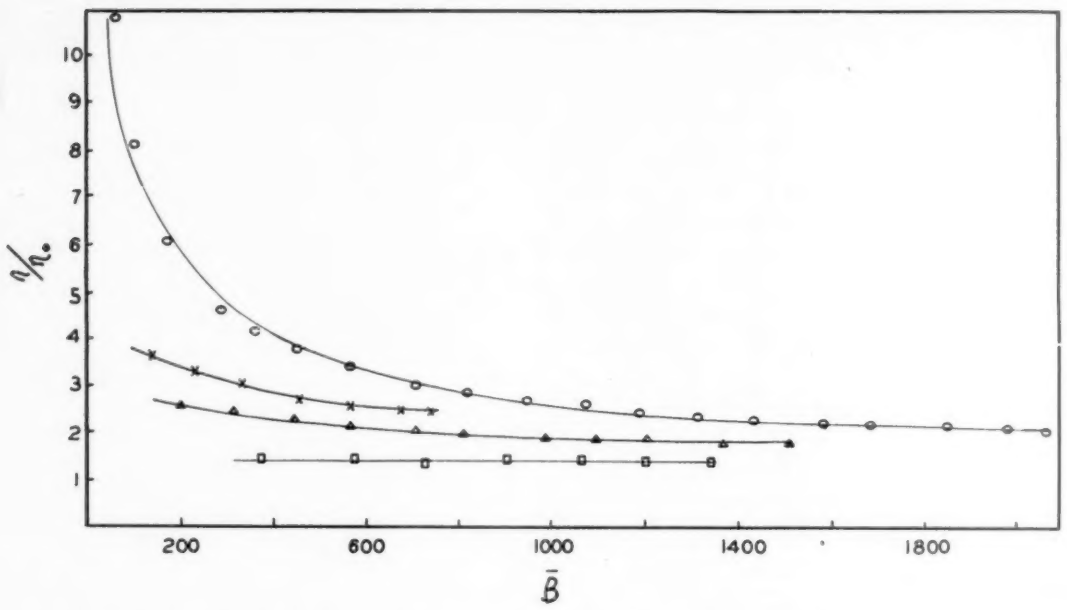

FIG. 3. Effect of $FeSO_4+H_2O_2$ on structural viscosity of DNA solution No. 2 (0.196%). ○ Control; × 10^{-1} M thiourea $+10^{-4}$ M $FeSO_4+10^{-3}$ M H_2O_2 20 hr.; △ 10^{-1} M thiourea $+10^{-4}$ M $FeSO_4+10^{-3}$ M H_2O_2 48 hr.; □ 10^{-4} M $FeSO_4+10^{-3}$ M H_2O_2 15 min.

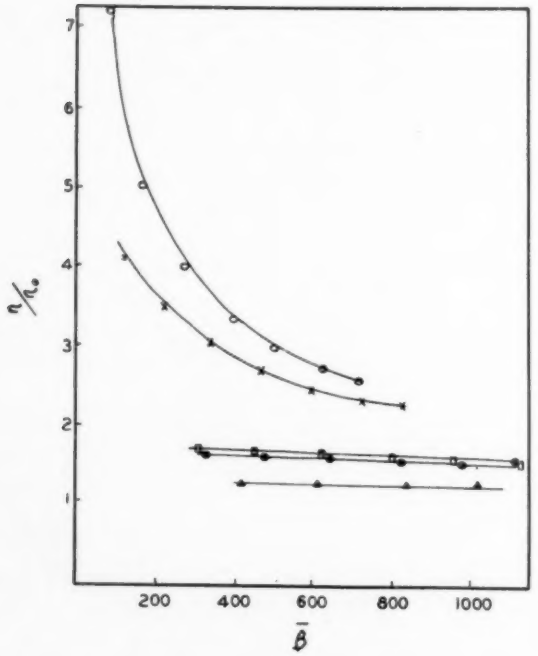

FIG. 4. Effect of ascorbic acid $+H_2O_2$ on structural viscosity of DNA solution No. 1 (0.136%, pH 8.5). ○ Control; × 10^{-3} M ascorbic acid 15 min.; □ 10^{-3} M ascorbic acid 5 hr.; △ 10^{-3} M ascorbic acid 24 hr.; ● 10^{-3} M ascorbic acid $+10^{-4}$ M H_2O_2 15 min.

polymerizing agent when used alone or combined with 10^{-4} M H_2O_2 (Fig. 4). Thiourea inhibited the depolymerization. The depolymerization of DNA in solution No. 1 (pH 8.5) with 10^{-3} M ascorbic acid took place slowly over a period of twenty-four hours while in solution No. 2 (pH 6.2) depolymerization took place immediately (Table 1). When 10^{-4} M H_2O_2 was added to ascorbic acid in solution No. 1 depolymerization took place immediately.

Potassium persulfate and sodium perborate in concentration as low as 10^{-3} M depolymerized DNA solutions (Table 1). Thiourea accelerated the effect of potassium persulfate, but inhibited the effect of sodium perborate in solution No. 2 (Table 1).

Roentgen Irradiation of DNA in Absence of Water. Air-dried DNA was subjected to a roentgen-ray dose of 100,000 r (3,300 r/min.) to determine the effect in the absence of water. Solutions prepared from the irradiated dry material showed only slight depolymerization, whereas solutions of the same concentration were completely

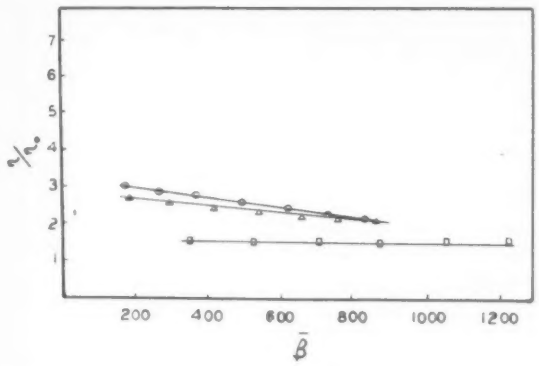

FIG. 5. Effect of roentgen irradiation on structural viscosity of DNA solution No. 3 (0.218%). ○ Control; △ 100,000 r DNA irradiated dry; □ 100,000 r.

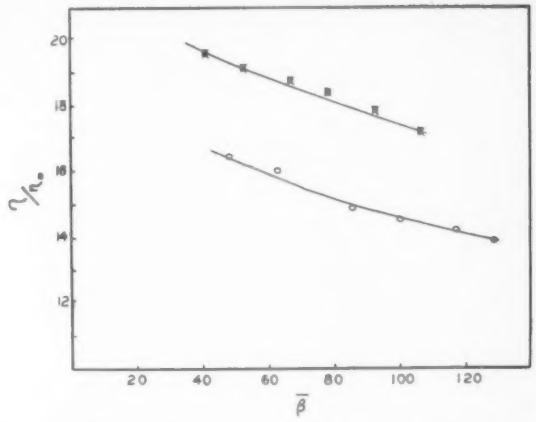

FIG. 6. Effect of roentgen irradiation on structural viscosity of ethylene glycol-DNA (No. 3) solution. × Control ethylene glycol-DNA; □ 100,000 r 24 hr.; ○ Ethylene glycol.

depolymerized when irradiated (Fig. 5). Ethylene glycol was used as a solvent for DNA. A 0.21 per cent solution of DNA in ethylene glycol was irradiated in a 10 ml. serum bottle with a dose of 100,000 r. The DNA was unaffected (Fig. 6).

Roentgen Irradiation of Frozen DNA Solution. For the roentgen irradiation of the frozen DNA solutions a General Electric Maximar roentgen therapy machine (self-rectified) operating at 250 kv. (peak) and 15 ma. and at a rate of 900 r/min. was used. No filter was used other than an inherent filter of 3 mm. of aluminum. A sample of DNA solution No. 2 in a 10 ml. serum bottle was frozen in a vacuum bottle with dry ice and irradiated while in a frozen state. A second sample was irradiated with the same dose at room temperature. The DNA in the frozen solution was almost

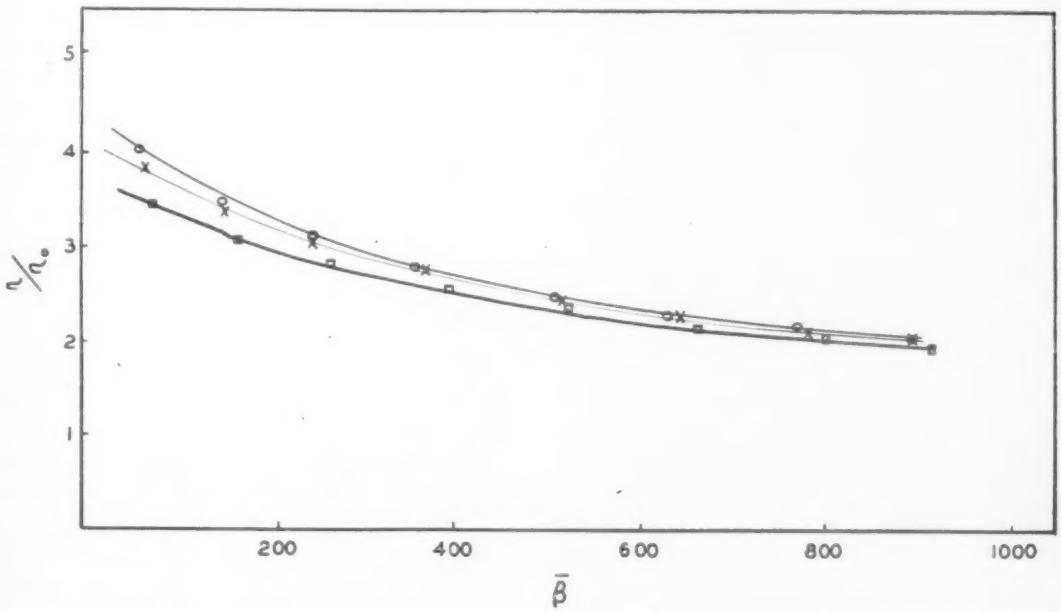

FIG. 7. Effect on structural viscosity of roentgen irradiation of DNA solution No. 2 (0.262%) in frozen state and at room temperature. ○ Control; × 25,000 r frozen solution 24 hr.; □ 25,000 r room temperature 24 hr.

completely unaffected while the sample irradiated at room temperature was depolymerized to some extent (Fig. 7).

Hydrogen Bonding in DNA Solutions. Evidence of hydrogen bonding in DNA was provided by the use of ethylene glycol as a solvent. Ethylene glycol solutions of DNA showed no streaming birefringence. Although ethylene glycol showed structural viscosity, the solutions of DNA did not show any greater structural viscosity but only a greater relative viscosity. Aqueous solutions of DNA, on the other hand, exhibited intense streaming birefringence and structural viscosity. The sedimentation velocity of DNA in ethylene glycol was about seven times greater than in aqueous solution (Fig. 8). Since the sedimentation velocity of DNA in ethylene glycol was greater but no streaming birefringence nor structural viscosity due to DNA was evident, the increased molecular

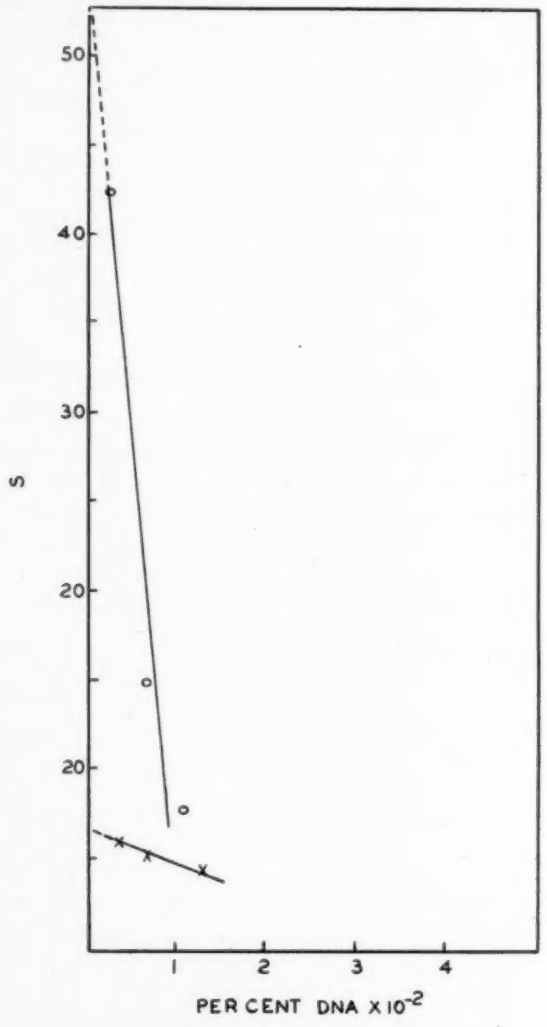

FIG. 8. Sedimentation constants (S) of DNA in water and in ethylene glycol. × Water; ○ Ethylene glycol.

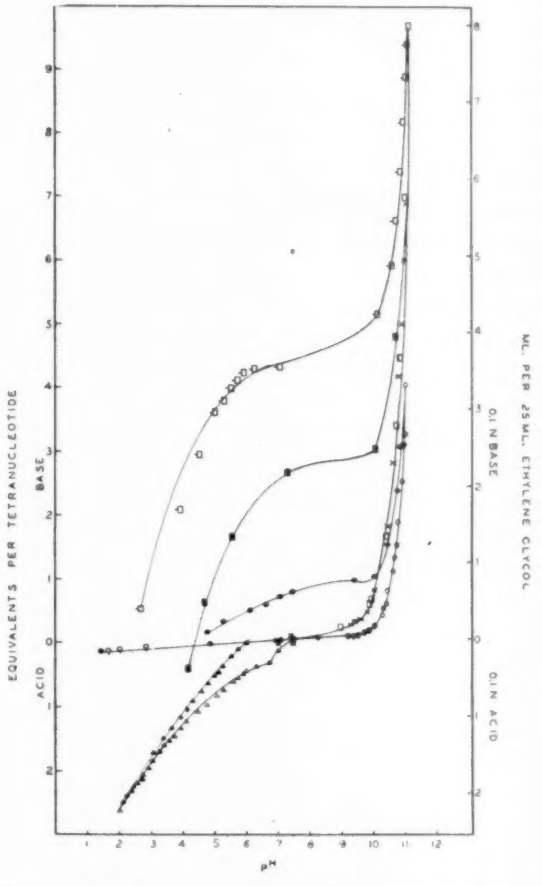

FIG. 9. Titration of ethylene glycol solutions of DNA (No. 3). ○ Titration of 25 ml. of ethylene glycol with 0.1 N NaOH. ◐ Back titration of 25 ml. of ethylene glycol with 0.1 N HCl. ● Titration of 25 ml. of ethylene glycol with 0.1 N HCl. ◌ Back titration of 25 ml. of ethylene glycol with 0.1 N NaOH. × Titration of 15 ml. of ethylene glycol-DNA (0.445%) with 0.1 N NaOH. ■ Back titration of 15 ml. of ethylene glycol-DNA (0.445%) with 0.1 N NaOH. △ Titration of 25 ml. of ethylene glycol-DNA (0.445%) with 0.1 N HCl. ▲ Back titration of 25 ml. of ethylene glycol-DNA (0.445%) with 0.1 N NaOH. □ Titration of 25 ml. of ethylene glycol-DNA (0.445%) with 0.2 N NaOH. -□ Back titration of 25 ml. of ethylene glycol-DNA (0.445%) with 0.123 N HCl.

size must have been due to cross linkages rather than end-to-end linkages. This was possibly due to the presence of two hydroxyl groups in ethylene glycol each of which could enter into hydrogen bonding with DNA. The ultraviolet absorption spectrum of DNA in ethylene glycol did not vary from that of DNA in aqueous solution.

Ethylene glycol solutions of DNA were titrated with acid and base to determine whether or not the same type of titration curves could be obtained as was obtained by Gulland *et al.*[12] in aqueous solutions of DNA. The titration curves obtained for ethylene glycol alone and for ethylene glycol solutions of DNA are shown in Figure 9. That back titration with either acid or base does not follow the initial titration may be seen from the curves. This was also found when ethylene glycol alone was titrated with base and back titrated with acid. Titration of ethylene glycol with acid and back titration with base showed no deviation. The deviation from the original curve on back titration may possibly be explained by a "salt effect" or by the complex nature of the medium. The titration curve obtained by titrating the ethylene glycol-DNA solution does not follow the titration curve obtained by titrating ethylene glycol alone. The change is more gradual in the former case, especially when titrating with acid. This may be explained in the same manner as in the titration of an aqueous solution of DNA, i.e., by the liberation of amino groups and either enol or imino groups. In the region of pH 6 to 7.5 in the titration curve of ethylene glycol-DNA the presence of a small amount of secondary phosphoryl group seems to be indicated as was indicated in the titration of aqueous solutions of DNA by Gulland *et al.*[12]

Effect of NaCl and Desoxyribosenuclease on Roentgen Irradiation of DNA. The addition of 1 per cent NaCl to solution No. 2 (0.196 per cent) caused a sharp drop in the viscosity within fifteen minutes. If allowed to stand at 30° C., the viscosity of the solution gradually increased until the original viscosity was attained after twenty-four hours. Roentgen irradiation with 20,000 r (3,300 r/min.) immediately or twenty-four hours after the addition of NaCl and desoxyribosenuclease caused about the same amount of depolymerization (Fig. 10). The presence of the NaCl

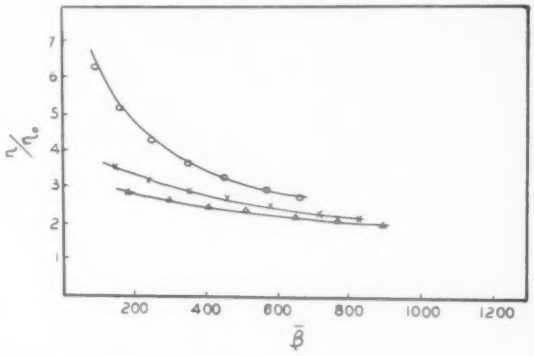

FIG. 10. Effect of DNA depolymerase and roentgen irradiation on DNA solution No. 2 (0.196%). ○ Control; × 1% NaCl + DNA depolymerase 24 hr.; △ 1% NaCl + DNA depolymerase + 20,000 r 24 hr.

and desoxyribosenuclease neither inhibited nor increased the effect of roentgen irradiation.

Sedimentation Studies. The relative changes in the structural viscosity and streaming birefringence indicate the degree of asymmetry of the solute. Since changes other than depolymerization can produce a more symmetrical molecule, the sedimentation velocity was used as a final criterion of molecular size. Varied results have been obtained by several workers[6,13] in the sedimentation of DNA due to the differences in the sources of materials and methods of preparation. Comparison of the control solutions with the depolymerized solutions at the same concentration showed that the latter had a higher sedimentation velocity which was due to the great decrease in their viscosity. For this reason the sedimentation constants were corrected for the viscosity of the solutions according to Lauffer.[15] A more accurate comparison was obtained in this manner even though there may have been an over correction.

The sedimentation curves obtained for the control solutions were all sharp spikes (Fig. 11). Depolymerization by either roentgen irradiation or by chemical means was evident from the broad peaks. A Beams type, air-driven ultracentrifuge with a Philpot-Svennson optical system was used.

DISCUSSION

Since depolymerization of desoxyribosenucleic acid in aqueous solution was accomplished by roentgen irradiation as well as by chemically generated free radicals and either 10^{-1} M H_2O_2 or $K_2S_2O_8$ depolymerization was accelerated. Reducing agents generally accelerate emulsion polymerization with H_2O_2, $K_2S_2O_8$, or $NaBO_3$[1,3]. In the case of H_2O_2 or $K_2S_2O_8$ thiourea accelerated the production of free radicals probably by accelerating the decomposition of these compounds. The reason why thiourea inhibited the depolymerization of DNA by $NaBO_3$, is not known. In the depolymerization of DNA by hydroxyl free radicals generated by the reduction of H_2O_2 by ferrous ions, thiourea probably

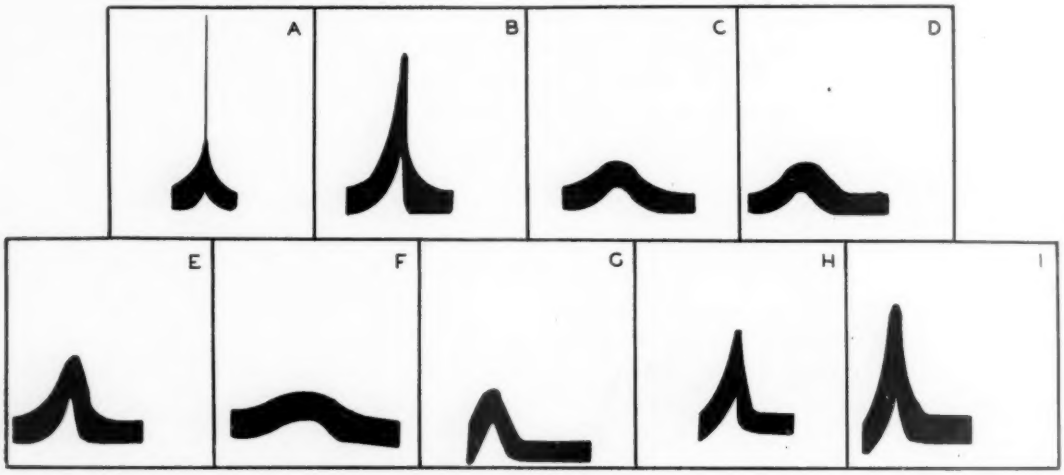

FIG. 11. Sedimentation of DNA solution No. 2 (0.196%) 20 min. A. Control; B. 10^{-1} M H_2O_2; C. 10^{-2} M thiourea $+10^{-1}$ M H_2O_2; D. 10^{-3} M $FeSO_4+10^{-2}$ M H_2O_2; E. 10^{-3} M $K_2S_2O_8$; F. 10^{-3} M $K_2S_2O_8+10^{-1}$ M thiourea; G. 10^{-3} M ascorbic acid; H. 10^{-3} M $NaBO_3$; I. Irradiated 50,000 r.

thiourea inhibited the depolymerization in both cases, it appears that the mechanism of roentgen-ray depolymerization is indirect, mediated through the production of free radicals from the solvent.

In addition to the hydroxyl free radicals generated in the reduction of H_2O_2 by ferrous ions, free radicals used in emulsion polymerization such as H_2O_2, $K_2S_2O_8$, and $NaBO_3$ readily depolymerized DNA. The concentration of H_2O_2 necessary was 10^{-1} M whereas $K_2S_2O_8$ or $NaBO_3$ in a concentration of only 10^{-3} M was sufficient to deploymerize DNA. Thiourea inhibited the depolymerization by the free radicals generated in the reaction of ferrous ions with H_2O_2 and also by $NaBO_3$, but with inhibited the reaction by competing with the DNA for the hydroxyl free radicals.

Although ascorbic acid was originally intended as a reducing agent for H_2O_2, it was found that it depolymerized DNA alone as well as in conjunction with H_2O_2. Solution No. 2 at pH 6.2 was immediately depolymerized while solution No. 1 at pH 8.5 was depolymerized slowly over a period of twenty-four hours. According to Weissberger *et al.*[20] ascorbic acid at a pH 1–7 exists in the monovalent state and is readily oxidized by atmospheric oxygen to dehydroascrobic acid and H_2O_2. They believe that an intermediate semiquinone-type compound is formed during the oxidation. It is very likely, therefore, that the depoly-

merization of DNA at pH 6.2 results from the production of semiquinone or free radicals. Solution No. 1 at pH 8.5 was depolymerized immediately by ascorbic acid plus H_2O_2 which independently were either unable to depolymerize DNA or did so at a very slow rate. This strongly suggests that the depolymerization is due to some product of the reaction of H_2O_2 with ascorbic acid possibly an intermediate free radical. It is significant that thiourea inhibited the depolymerization produced by ascorbic acid alone or combined with H_2O_2.

The inability to depolymerize DNA in the dry state, in ethylene glycol, or in a frozen aqueous solution by roentgen irradiation provided further evidence that the mechanism is indirect. If the mechanism were direct, the DNA would be depolymerized under all three conditions. The results obtained by the irradiation of DNA in the dry state and in ethylene glycol indicate the necessity for water or some solvent that can absorb roentgen-ray energy and thus produce free radicals which in turn can act on the solute. Although water was present in the frozen solution, the great increase in the association of the water molecules probably "caged in" the H· and ·OH radicals and also decreased their mobility thus preventing them from reacting with the DNA.

SUMMARY

Desoxyribosenucleic acid (DNA) was found to be depolymerized in aqueous solution by roentgen irradiation as well as by chemically generated free radicals; thiourea inhibited depolymerization by both means. *These results were interpreted as evidence that the mechanism of the action of roentgen irradiation of DNA in aqueous solution is indirect, mediated through the production of free radicals from the solvent.* The extent of the depolymerization was determined by the measurement of the structural viscosity, the streaming birefringence, and the sedimentation constants of the DNA solutions.

Additional evidence that the mechanism is indirect was obtained by the inability to depolymerize DNA in a dry state, in ethylene glycol, or in a frozen aqueous solution by roentgen irradiation.

The presence of NaCl and desoxyribosenuclease was found to neither inhibit nor increase the depolymerization of DNA in aqueous solution by roentgen irradiation.

Evidence of hydrogen bonding in DNA was provided by the use of ethylene glycol as a solvent.

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ROENTGEN IRRADIATION OF DESOXYRIBOSENUCLEIC ACID

II. PHYSICOCHEMICAL PROPERTIES OF DESOXYRIBOSENUCLEIC ACID FROM IRRADIATED RATS*

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THE depolymerization of desoxyribosenucleic acid (DNA) in aqueous solution by roentgen irradiation as well as by chemically generated free radicals was described previously.[4] Thiourea was found to inhibit depolymerization by both means. These results were interpreted as evidence for an indirect mechanism for roentgen irradiation of DNA in aqueous solution, mediated through the production of free radicals (OH, H, etc.) from the solvent. Additional evidence for the indirect mechanism was obtained by the inability to depolymerize DNA in a dry state, in ethylene glycol, or in a frozen aqueous solution by roentgen irradiation. Although the mechanism of roentgen irradiation *in vitro* may not necessarily be the same as in a complex biological system such as a cell, it is conceivable that DNA is depolymerized *in vivo* by roentgen irradiation as well as *in vitro*. Disturbances of the nucleic acid metabolism by therapeutic doses of roentgen rays has been found by several workers.[3,6] Roentgen irradiation was found to reduce the nucleic acid content in certain tissues. An explanation of the mechanism by which the nucleic acid content is reduced would be of value in understanding the mechanism of cell destruction. The study of the physicochemical properties of DNA isolated from roentgen irradiated animals should therefore indicate whether or not depolymerization took place.

It was found that when the animals were sacrificed twenty-four hours after irradiation with 1,000 roentgens, the DNA isolated from the thymus tissue was completely depolymerized as determined by the structural viscosity, streaming birefringence, and sedimentation constants of the solutions of DNA. Thiourea, injected before irradiation, inhibited the depolymerization to some extent. When the animals were sacrificed immediately after irradiation with 1,000 r and 2,000 r, the DNA extracted from the thymus was low in nitrogen due to a splitting off of purine bases. This was confirmed by the analysis of the purine N/pyrimidine N and also by the ultraviolet absorption spectra of the DNA solutions.

MATERIALS AND METHODS

The same viscometer-pressure system, streaming birefringence apparatus, and roentgen-ray machine were used as described previously.[4] A Beckman quartz spectrophotometer was used to obtain the ultraviolet absorption spectra of the solutions.

Male albino rats weighing 125–180 grams from the Albino Farms, Red Bank, N. J., were maintained on a diet of Fox Food Blox (Allied Mills) and irradiated in groups of 10 in a circular copper cage with a 0.75 mm. copper filter. The thymus tissues from 5 rats were combined for each solution with one exception. When the rats were irradiated with 1,000 r and sacrificed twenty-four hours after irradiation, 20 rats per solution had to be used because the thymus tissues were considerably reduced in size by the irradiation. Essentially the same procedure was used for extracting DNA from rat thymus tissue as was described previously.[4] The pH of the salt solutions used in the extraction as well as the final solutions was adjusted to 10.75 since a more complete removal of the protein was obtained at this pH. Mirsky and Pollister[5] had

* Results presented in this paper were a part of the thesis presented by George Limperos to the Chemistry Department of the University of Delaware in partial fulfillment of the requirements for the Degree of Doctor of Philosophy, September, 1949.

TABLE I

STREAMING BIREFRINGENCE AND STRUCTURAL VISCOSITY OF DNA SOLUTIONS (0.027%) FROM THYMUS OF RATS

Controls			Sacrificed Immediately after Roentgen Irradiation						Sacrificed 24 hr. after Roentgen Irradiation					
			1000 r			2000 r			1000 r			Thiourea +1000 r		
Soln. No.	Str. Brfrg., mm.	ν_∞	Soln. No.	Str. Brfrg., mm.	ν_∞	Soln. No.	Str. Brfrg., mm.	ν_∞	Soln. No.	Str. Brfrg., mm.	ν_∞	Soln. No.	Str. Brfrg., mm.	ν_∞
10	45	3098	16	50	3770	31	50	3400	42	0	1585	60	20	1660
11	45	2950	17	50	3470	32	50	3630	46	0	1510	61	30	1810
12	45	2790	18	50	3250	33	45	3770	47	0	1585	63	25	1510
14	55	3920	19	35	2870	34	25	2640	53[c]	0	2000	67	30	1660
15	50	3720	20	50	3630	35	50	4000	54[d]	0	2220	68	25	1510
26	45	3098	21	50	3630	36	50	4225	55[e]	0	1400	69	25	1660
27	55	3250	22	50	3470	37	50	3400	56	0	1510	70	25	1660
28	45	3098	23	45	2640	38	50	3400	57	0	1510	71	25	1660
29[a]	50	4100	24	30	2410	39	50	3400	58	0	1510	72	25	1510
30[b]	45	4350	25	25	2410	40	50	3400	59	0	1360	73	25	1510
Mean	48	3432	Mean	43.5	3155	Mean	47	3549	Mean	0	1620	Mean	25.5	1615

[a] (0.018%). [b] (0.017%). [c] (0.020%). [d] (0.018%). [e] (0.020%).

found that it was necessary to raise the pH to 10–11 in order to completely remove the protein. A borate buffer was therefore used for all solutions. The DNA was not isolated as it had been in the *in vitro* preparations, but after the final treatment with chloroform the DNA extract was dialyzed against the borate buffer (10 ml.:250 ml.) over night in the refrigerator. It was dialyzed a second time for five hours (10 ml.:250 ml.). The total time required for the preparation of each solution was about six hours before dialysis. The solutions were then analyzed for nitrogen and phosphorus and were diluted to the same concentration of DNA based on the concentration of phosphorus. The solutions were stable for several months.

RESULTS

Immediate Effects of Roentgen Irradiation. When the rats were sacrificed immediately after roentgen irradiation with either 1,000 r (63 r/min. and 78 r/min.) or 2,000 r

TABLE II

N/P RATIOS OF DNA SOLUTIONS FROM THYMUS OF RATS

Controls		Sacrificed Immediately after Roentgen Irradiation						Sacrificed 24 hr. after Roentgen Irradiation			
		1000 r		2000 r		thiourea +1000 r		1000 r		thiourea +1000 r	
Soln. No.	N/P	Soln. No.	N/P	Soln. No.	N/P	Soln. No.	N/P	Soln. No.	N/P	Soln. No.	N/P
10	1.82	16	2.00	31	0.75	74	1.79	42	1.96	60	2.05
11	1.71	17	1.94	32	0.87	75	1.83	46	1.78	61	2.70
12	1.82	18	1.45	33	0.79	76	1.64	47	1.81	63	2.06
14	2.12	19	1.50	34	1.32	77	1.74	53	4.15	67	1.62
15	2.00	20	1.81	35	2.07	78	1.76	54	2.29	68	2.25
26	1.75	21	1.77	36	2.27	79	2.00	55	1.84	69	2.35
27	1.65	22	1.66	37	1.17	80	1.99	56	1.72	70	1.89
28	1.95	23	1.10	38	1.03	81	1.93	57	2.02	71	1.76
29	1.76	24	1.49	39	1.03	82	1.95	58	1.90	72	1.83
30	1.87	25	1.12	40	0.94	83	1.54	59	1.61	73	2.34
Mean	1.84	Mean	1.58	Mean	1.22	Mean	1.82	Mean	1.21	Mean	2.08

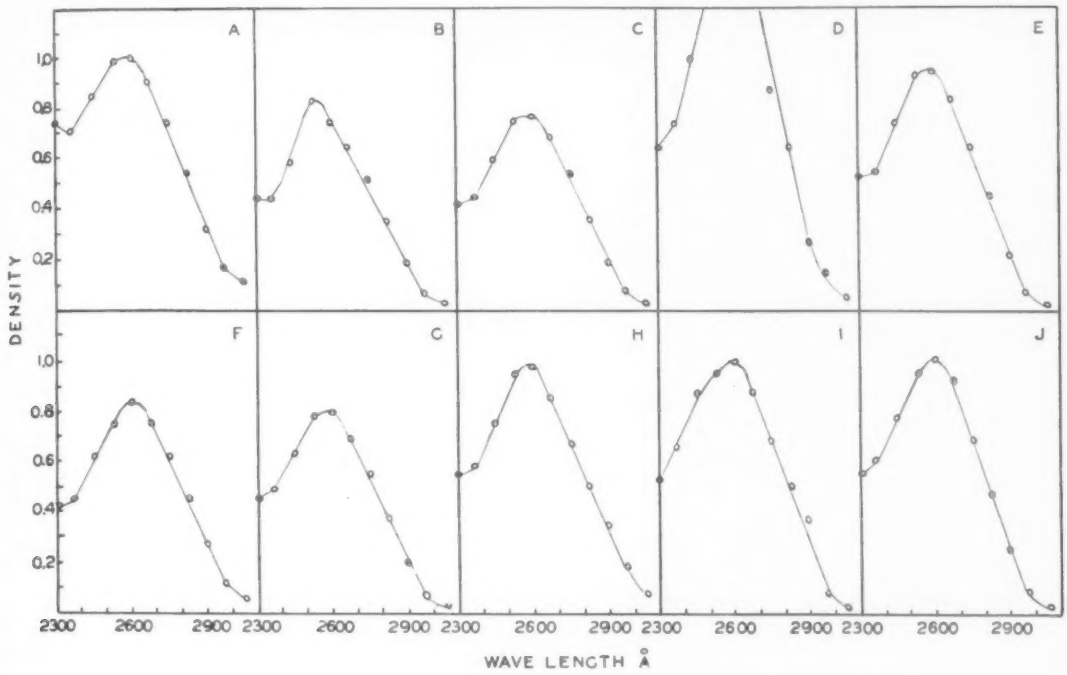

FIG. 1. Ultraviolet absorption spectra of control DNA solutions (0.0045%) prepared from rat thymus. (*A*) Solution No. 10 N/P = 1.82; (*B*) Solution No. 11 N/P = 1.71; (*C*) Solution No. 12 N/P = 1.82; (*D*) Solution No. 14 N/P = 2.12; (*E*) Solution No. 15 N/P = 2.00; (*F*) Solution No. 26 N/P = 1.75; (*G*) Solution No. 27 N/P = 1.65; (*H*) Solution No. 28 N/P = 1.95; (*I*) Solution No. 29 N/P = 1.76; (*J*) Solution No. 30 N/P = 1.87.

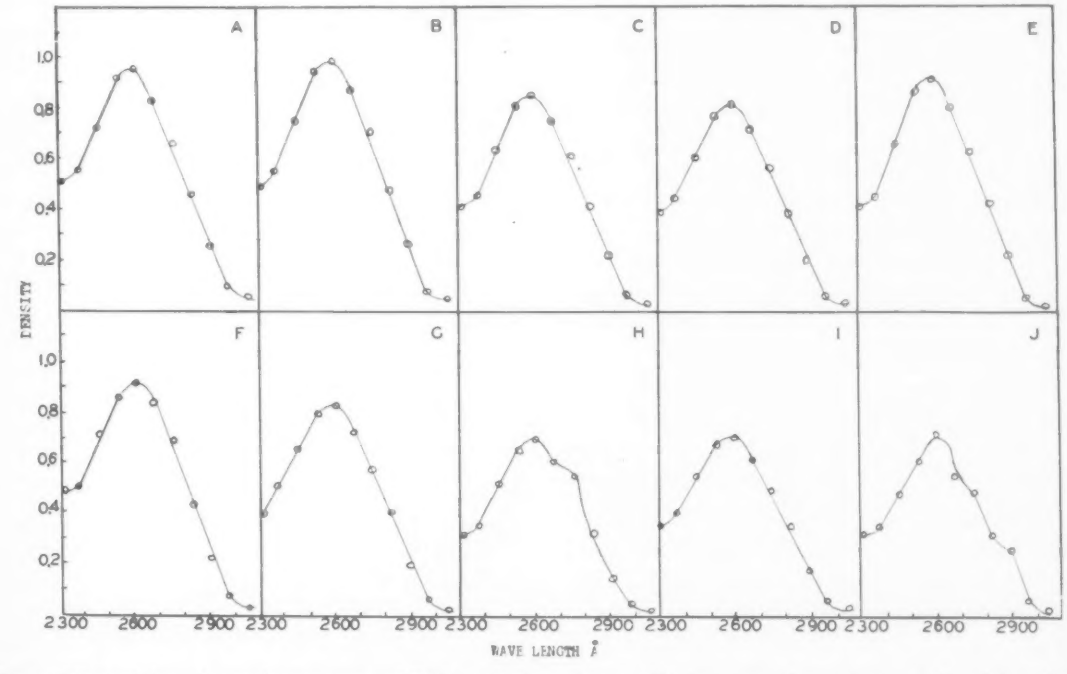

FIG. 2. Ultraviolet absorption spectra of DNA solutions (0.0045%) prepared from thymus of rats irradiated with 1,000 r and sacrificed immediately. (*A*) Solution No. 16 N/P = 2.00; (*B*) Solution No. 17 N/P = 1.94; (*C*) Solution No. 18 N/P = 1.45; (*D*) Solution No. 19 N/P = 1.50; (*E*) Solution No. 20 N/P = 1.81; (*F*) Solution No. 21 N/P = 1.71; (*G*) Solution No. 22 N/P = 1.66; (*H*) Solution No. 23 N/P = 1.10; (*I*) Solution No. 24 N/P = 1.49; (*J*) Solution No. 25 N/P = 1.12.

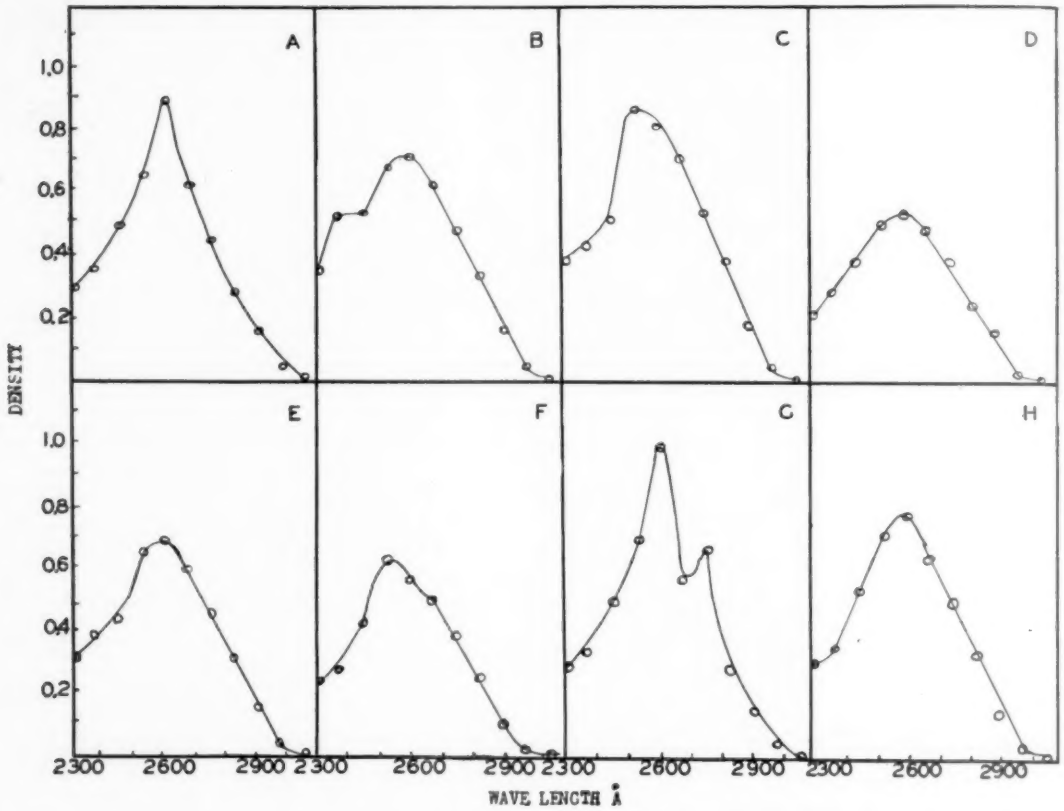

FIG. 3. Ultraviolet absorption spectra of DNA solutions (0.0045%) prepared from thymus of rats irradiated with 2,000 r and sacrificed immediately. (*A*) Solution No. 31 N/P = 0.75; (*B*) Solution No. 32 N/P = 0.86; (*C*) Solution No. 33 N/P = 1.79; (*D*) Solution No. 34 N/P = 1.32; (*E*) Solution No. 37 N/P = 1.17; (*F*) Solution No. 38 N/P = 1.03; (*G*) Solution No. 39 N/P = 1.03; (*H*) Solution No. 40 N/P = 0.94.

(236 r/min. and 170 r/min.), there was no depolymerization of the DNA (Table I). However, the N/P ratios of the DNA solutions obtained from the irradiated animals were much lower than that of the controls (Table II). The mean of the N/P ratios for the controls was 1.84 ,whereas for the 1,000 r group it was 1.58 and for the 2,000 r group it was 1.22. These results indicated that a splitting off of either purine or pyrimidine base had occurred. An examination of the ultraviolet absorption spectra showed that the solutions from the irradiated animals had a lower absorption at 2,600 Å and in some cases there were irregularities in the absorption curves (Fig. 1, 2, 3, and 4). An analysis of the purine N/pyrimidine N ratios showed that the decrease in the N/P ratio was due to a decrease in the purine content of the DNA from the irradiated animals.

Analysis:

Controls (solutions No. 11, 12, 26, 28, 29, and 30 were combined)
purine N/pyrimidine N = 1.91
Roentgen irradiated (solutions No. 23, 31, 32, 33, 34, 37, 39, and 40 were combined)
purine N/pyrimidine N = 1.51
Theoretical purine N/pyrimidine N = 2.00 ("statistical tetranucleotide")

In order to determine the effect of thiourea on the decrease in the N/P ratio due to roentgen irradiation, rats were injected intraperitoneally with an aqueous solution of thiourea before irradiating with 1,000 r (75 r/min., new roentgen-ray machine as described for the irradiation of the frozen

DNA solution previously.[4]) The thiourea solution (9 g./ml.) was injected in three doses one-half hour apart, a total dose of 2,600 mg./kilo body weight. After the third injection the animals were irradiated immediately and then sacrificed. The average N/P ratio of the solutions obtained from these animals was only slightly lower than that of the controls (Table II), but two ratio of the solutions was found when the animals were sacrificed 24 hours after irradiation with 1,000 r (170 r/min.) (Table II). However, depolymerization of the DNA had taken place as indicated by the complete lack of streaming birefringence (Table I) and the decreased values for the structural viscosity (Table I, Fig. 5 and 6) and sedimentation velocity (Table III).

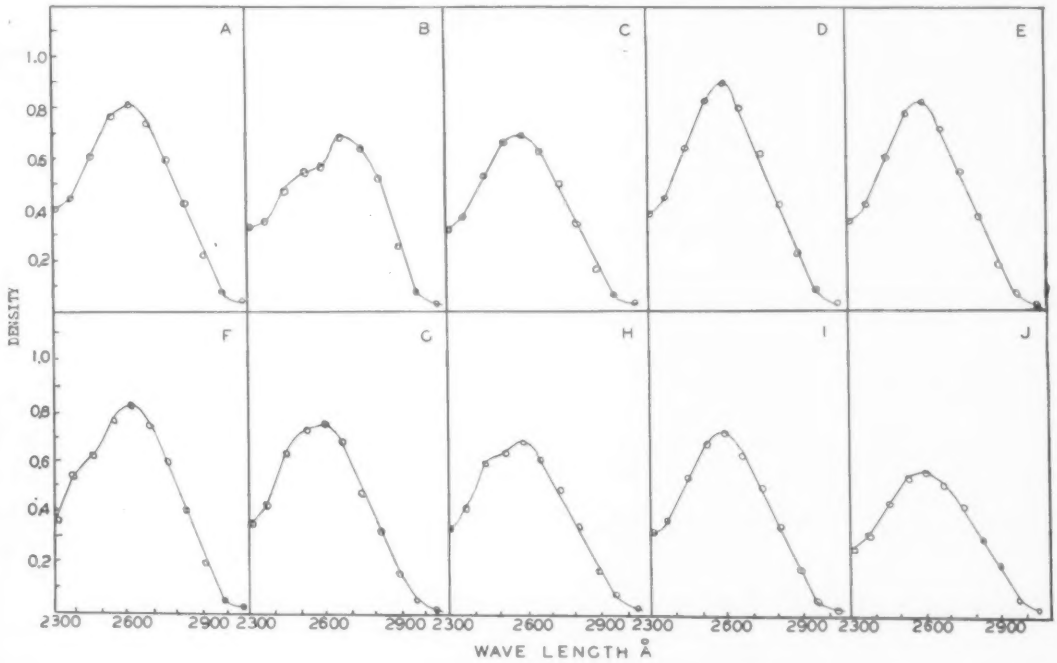

Fig. 4. Ultraviolet absorption spectra of DNA solutions (0.0045%) prepared from thymus of rats injected with thiourea, irradiated with 1,000 r, and sacrificed immediately. (*A*) Solution No. 74 N/P = 1.79; (*B*) Solution No. 75 N/P = 1.83; (*C*) Solution No. 76 N/P = 1.64; (*D*) Solution No. 77 N/P = 1.74; (*E*) Solution No. 78 N/P = 1.76; (*F*) Solution No. 79 N/P = 2.00; (*G*) Solution No. 80 N/P = 1.99; (*H*) Solution No. 81 N/P = 1.93; (*I*) Solution No. 82 N/P = 1.95; (*J*) Solution No. 83 N/P = 1.54.

solutions (No. 76 and 83) had a lower ratio than the theoretical 1.69. The ultraviolet absorption spectra of these solutions revealed that about the same number of solutions had a lower absorption at 2,600 Å as in the group irradiated with 1,000 r without thiourea (Fig. 2 and 4).

Analysis:

4 ml. each of solutions No. 74, 76, 77, 78, and 83 were combined
purine N/pyrimidine N = 1.81

Effects of Roentgen Irradiation after Twenty-four Hours. No decrease in the N/P

When thiourea was injected before irradiation in the same doses as those given to animals that were sacrificed immediately after irradiation, depolymerization was inhibited to some extent (Tables I and III; Fig. 7).

Absorption of Thiourea in Thymus Tissue. It had been shown by Williams and Kay[8] that thiourea is readily absorbed in all tissues of the rat. No data were given for the absorption in thymus tissue, however, and for this reason the absorption of thiourea by the rat thymus was investigated.

TABLE III

SEDIMENTATION CONSTANTS AND RELATIVE VISCOSITIES OF DNA SOLUTIONS (0.027%) FROM THYMUS OF RATS

	Soln. No.	Sedimentation Constants			Viscosity		
		Uncorrected	Corrected for viscosity		Correction factors		Relative at 30°
		S	solv. S	soln. S	solv.	soln.	
Controls	10	10.34	10.36	19.16	1.002	1.853	1.874
	11	13.40	13.30	23.09	0.983	1.784	1.851
	12	12.70	12.25	23.23	0.965	1.829	1.920
	14	10.15	9.74	22.07	0.960	2.175	2.295
	15	10.60	10.17	24.26	0.960	2.289	2.416
	26	12.40	11.90	18.54	0.960	1.495	1.578
	27	12.80	12.29	23.47	0.960	1.834	1.936
	28	13.70	14.09	25.30	1.029	1.847	1.819
	29[a]	13.60	14.75	25.62	1.085	1.864	1.759
	30[b]	13.60	13.80	24.02	1.015	1.766	1.783
	Mean	12.33	12.26	22.87			1.920
Irradiated 1000 r, sacrificed after 24 hours	42	9.97	9.94	14.25	0.997	1.429	1.452
	46	9.04	9.43	13.48	1.044	1.429	1.448
	47	8.17	8.60	12.69	1.053	1.554	1.495
	53[c]	9.43	9.48	13.37	1.006	1.418	1.428
	54[d]	10.00	10.45	14.25	1.039	1.417	1.382
	55[e]	9.97	10.72	14.13	1.075	1.417	1.336
	56	10.13	10.69	14.69	1.056	1.451	1.392
	57	10.10	10.18	15.54	1.077	1.539	1.448
	58	9.25	9.32	13.20	1.088	1.427	1.435
	59	10.07	10.06	13.96	0.999	1.387	1.407
	Mean	9.62	9.88	13.95			1.420
Injected with thiourea, irradiated with 1000 r, and sacrificed after 24 hours	60	11.42	11.75	17.03	1.029	1.491	1.470
	61	10.33	10.87	16.30	1.053	1.575	1.514
	63	11.80	11.31	16.02	0.960	1.360	1.440
	67	10.85	10.41	14.65	0.960	1.350	1.426
	68	11.00	10.55	15.82	0.960	1.440	1.522
	69	10.87	10.31	15.83	0.960	1.460	1.542
	70	10.40	9.98	14.98	0.960	1.440	1.523
	71	10.41	10.10	15.10	0.970	1.450	1.510
	72	10.95	10.62	15.78	1.970	1.440	1.504
	73	10.95	11.03	16.10	1.008	1.470	1.475
	Mean	10.90	10.70	15.76			1.490

[a] (0.018%). [b] (0.017%). [c] (0.020%). [d] (0.018%). [e] (0.020%).

The method used was identical with that used by Williams and Kay. The concentration of thiourea extracted was measured colorimetrically with a Klett colorimeter using a No. 66 filter. Aqueous solutions of thiourea were injected intraperitoneally in the same manner as in the irradiation experiments. A definite absorption of thiourea was found in the thymus of 12 rats (Table IV).

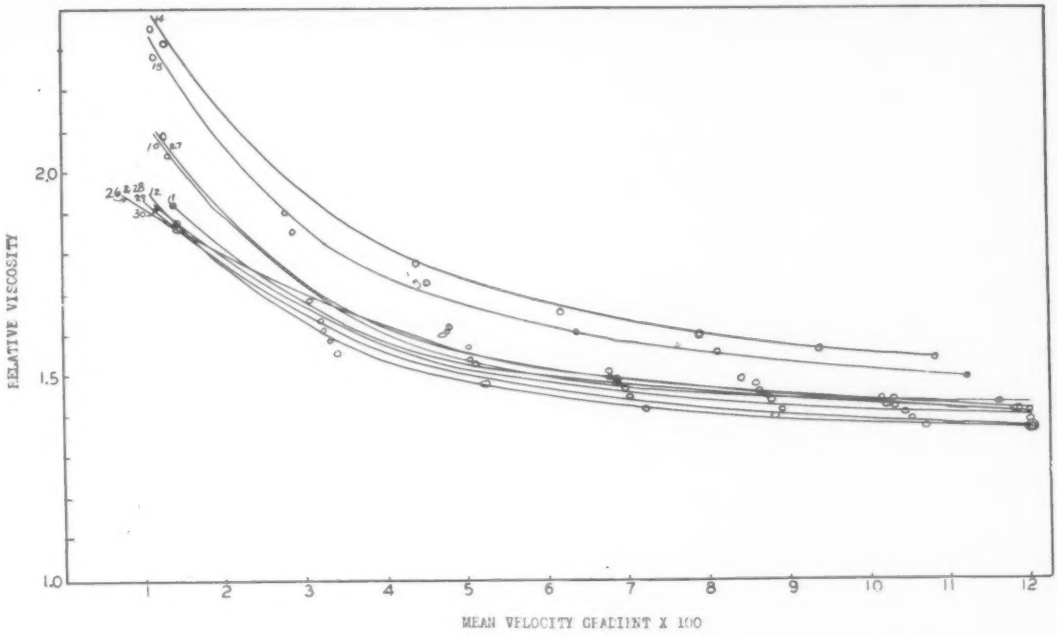

Fig. 5. Structural viscosity of control DNA solutions prepared from rat thymus.

DISCUSSION

Both an immediate and a delayed effect were found in the *in vivo* irradiation of rat thymus DNA. The splitting off of purine bases (about one base per tetranucleotide), which was the immediate effect, was not inhibited by the injection of thiourea before irradiation. The depolymerization of DNA, which was the delayed effect, was inhibited

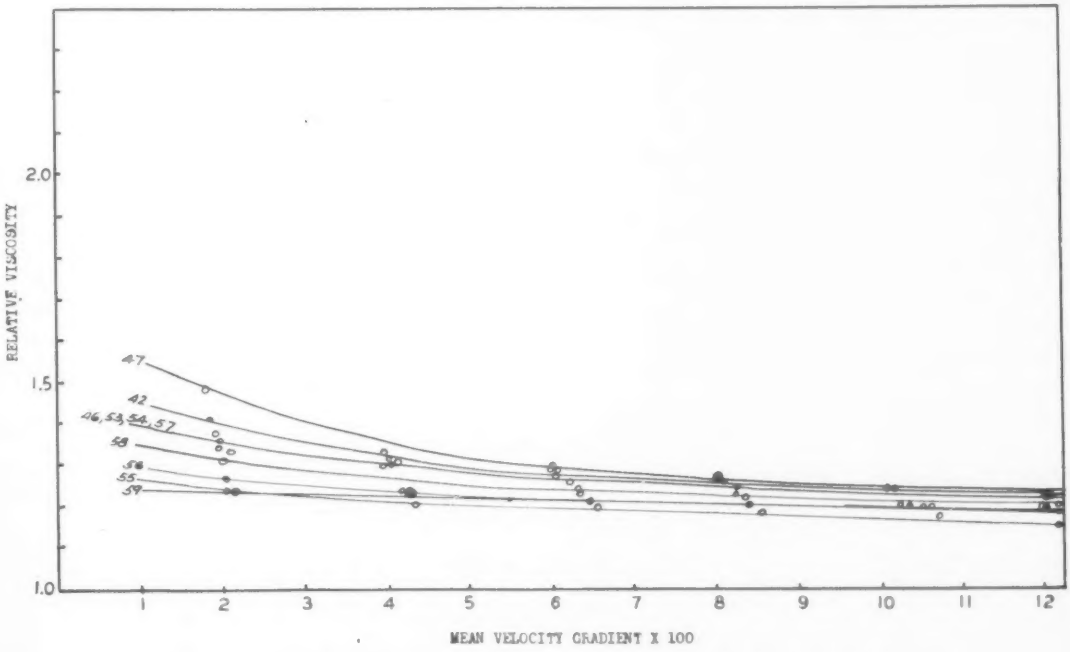

Fig. 6. Structural viscosity of DNA solutions prepared from thymus of rats irradiated *in vivo* with 1,000 r and sacrificed after twenty-four hours.

to some extent by the injection of thiourea before irradiation. The two effects observed suggest two separate mechanisms, since depolymerization occurred only after twenty-four hours and the splitting off of purine bases occurred only when the animals were sacrificed immediately after roentgen irradiation. The inability of thiourea to protect DNA against the immediate effect indicates that this mechanism is direct. The partial inhibition of the delayed effect by thiourea suggests that this mechanism is indirect possibly mediated through the production of free radicals. It is difficult, however, to see how free radicals, if they were produced, could be effective in the presence of other cellular constituents unless DNA were in a much more sensitive form *in vivo* than *in vitro*. The last hypothesis is not at all unlikely in view of the fact that extremely large doses are necessary to depolymerize DNA *in vitro*. The splitting off of purine bases as well as other molecular alterations by doses of $2\text{–}6\times 10^6$ r roentgen radiation *in vitro* has been reported.[7] The splitting off of purine bases from DNA may account for the increase in blood nitrogen and uric acid reported to occur after roentgen irradiation.[1,2] The normal N/P ratio found twenty-four hours after roentgen irradiation may be due to the synthesis of new DNA. Although physical and chemical changes have been found in rat thymus DNA, changes in the nucleic

TABLE IV

ABSORPTION OF THIOUREA IN RAT THYMUS

	Weight		Corrected Colorimeter Reading	Thiourea, mg. per cent	Thiourea, mg. per cent/g. Thymus
	Rat, grams	Thymus, grams			
Controls	136	0.42	3	0.39	0.33
	134	0.27	9	0.49	0.68
	146	0.26	17	0.63	0.87
	144	0.27	23	0.74	0.98
	152	0.40	23	0.74	0.67
	142	0.25	26	0.79	1.12
	150	0.30	20	0.69	0.83
	144	0.35	27	0.81	0.83
	150	0.25	22	0.72	1.04
	140	0.45	38	1.00	0.80
					0.82 Mean
Thiourea injected	143	0.26	75	1.65	2.28
	134	0.30	39	1.02	1.22
	150	0.25	56	1.31	1.89
	144	0.25	52	1.25	1.80
	142	0.30	57	1.34	1.61
	144	0.38	50	1.22	1.16
	136	0.24	39	1.02	1.53
	140	0.24	39	1.02	1.53
	133	0.23	34	0.94	1.47
	140	0.26	42	1.08	1.49
	142	0.32	45	1.13	1.27
	128	0.32	44	1.11	1.25
					1.54 Mean

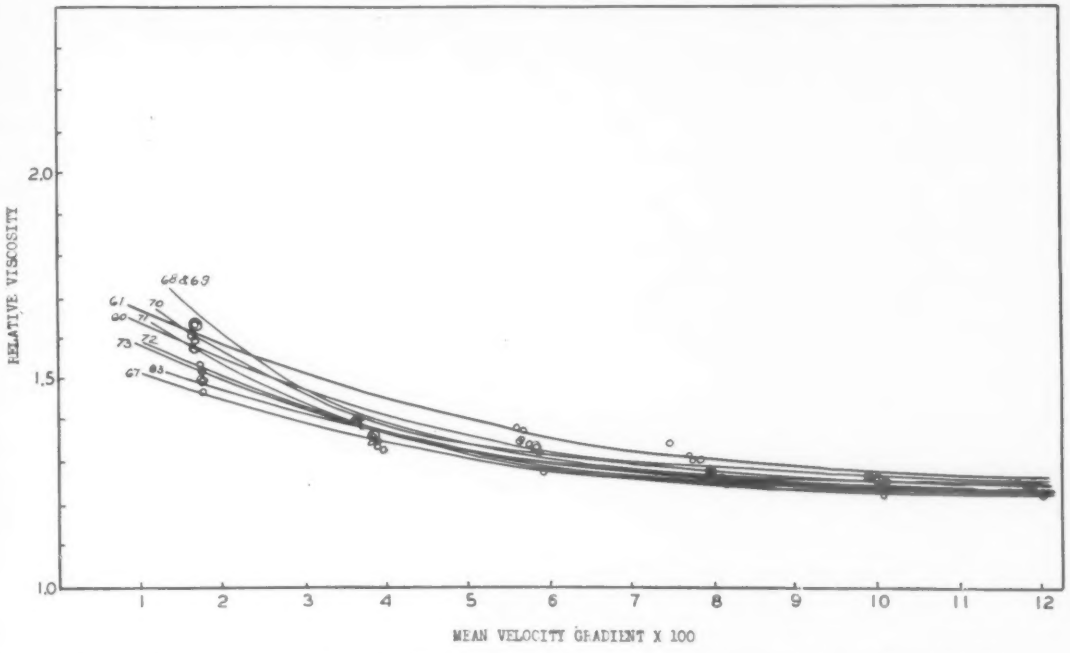

Fig. 7. Structural viscosity of DNA solutions prepared from thymus of rats injected with thiourea, irradiated with 1,000 r, and sacrificed after twenty-four hours.

acid of other tissues may not necessarily occur. Since thiourea was found to have some protective effect on DNA from rats irradiated *in vivo*, it is possible that thiourea can increase the survival of roentgen irradiated animals. This will be reported subsequently.

SUMMARY

Roentgen irradiation of rat thymus desoxyribosenucleic acid (DNA) *in vivo* produced two different effects. When the animals were sacrificed immediately after irradiation, the DNA extracted from the thymus was low in nitrogen. The purine N/pyrimidine N analysis and the ultraviolet absorption spectra of the DNA solutions revealed that the low nitrogen concentration was due to a splitting off of purine bases.

When the animals were sacrificed twenty-four hours after irradiation, the DNA was almost completely depolymerized as revealed by the structural viscosity, streaming birefringence, and the sedimentation constants of the DNA solutions.

Thiourea, injected before irradiation, did not inhibit the splitting off of the purine bases from the DNA but did inhibit the depolymerization to some extent. Possible mechanisms for these reactions are suggested.

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END RESULTS OF RADIOTHERAPY OF CANCER OF THE TONGUE*

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FROM 1919 to 1941, 1,055 patients with epithelioma of the tongue were treated at the Curie Foundation, Paris.

They have been divided into three groups according to the site of the primary lesion.

a. 86 epitheliomas of anterior third of the tongue (tip and under surface).
b. 638 epitheliomas of anterior two-thirds of the tongue (dorsum and edges).
c. 331 epitheliomas of posterior third of the tongue.

They are classified in the following manner:

Primary Lesion

Stage I: Lesions measuring 2 cm. in their greatest diameter.
Stage II: Lesions measuring from 2 to 3 cm. in diameter.
Stage III: Lesions measuring from 3 to 4 cm. in diameter, crossing the medial line interfering with extension of the tongue.
Stage IV: Lesions of more than 4 cm. in diameter, invading the floor of the mouth or pillars of the fauces; tongue more or less fixed.

Lymph Node Involvement

Stage I: No clinically evident metastases to lymph nodes.
Stage II: Clinically evident metastases to movable lymph nodes 2 to 3 cm. in diameter.
Stage III: Larger and fixed lymph nodes.
Stage IV: Lymph nodes over 4 cm., adherent to the skin, fixed.

Clinical Aspects of the Lesion in the Patients Treated. In the first group (group a, anterior third, tip and under surface) 86 cases were treated.

The epithelioma assumes two principal forms. It appears at times in the form of a small interstitial growth, causing a small elevation on the under surface of the tongue, reaching the tip or invading the proximity of the frenum linguae, covered by an ulceration smooth or ragged. More frequently, it is an irregular exophytic ulceration spreading above the mucosa or having a large pedicle. At times the tip of the tongue is partially destroyed by the tumor. These tumors are generally accompanied by submaxillary and submental lymph nodes and rarely by carotid lymph-nodes.

Among the 86 patients treated, the primary lesion was:

at Stage I in 8 cases
at Stage II in 21 cases
at Stage III in 37 cases
at Stage IV in 20 cases

The metastatic lymph nodes were:

at Stage I in 42 cases
at Stage II in 40 cases
at Stage III in 4 cases

In the second group (group b, anterior two-thirds of the tongue, edges and dorsum) 638 cases were treated.

Most frequently the epithelioma is situated in the posterior part of the margin of the tongue, 5 or 10 mm. in front of the anterior pillar of the fauces. In Stage I or II, it usually appears as an ovoid interstitial tumor, not reaching the medial line, more or less adherent to the overlying mucosa and deforming the margin of the tongue. The ulceration first begins at the periphery and frequently appears as an elongated slash of varying depth. In the more advanced stages, the ulceration becomes ragged, destroying partially the edges of the tongue, thickening it, and spreading on to the anterior pillar and pharyngeal part of the tongue. Interstitial

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induration develops at the same time, involving progressively the medial line and nearly the whole of the mobile part of the tongue and the floor of the mouth. Protrusion of the tongue becomes more and more reduced.

Among the 638 cases treated, there were:

121 Stage I cases
264 Stage II cases
185 Stage III cases
61 Stage IV cases
7 cases of secondary lymph nodes

The metastatic lymph nodes were:

at Stage I in 335 cases
at Stage II in 219 cases
at Stage III in 68 cases
at Stage IV in 16 cases

They were nearly always cervical lymph nodes.

In the third group (group c, posterior third of the tongue) 331 cases were treated.

At an early stage the tumor, situated on the pharyngeal part of the tongue, is interstitial with a small area of ulceration. In time, the ulceration increases in size and the infiltration invades progressively the whole of the posterior third, extending forward into the anterior two-thirds of the tongue and into the posterior part of the floor of the mouth.

Among the 331 cases treated, there were:

17 Stage I cases
84 Stage II cases
158 Stage III cases
72 Stage IV cases

The metastatic lymph nodes were:

at Stage I in 87 cases
at Stage II in 136 cases
at Stage III in 88 cases
at Stage IV in 20 cases

They were always cervical lymph nodes.

In the advanced cases it is not always easy to say where the origin of the growth was, but microscopic inspection may offer some help because the epitheliomas of the posterior third of the tongue are generally less differentiated than the others.

The lymph node involvement was classified according to the clinical appearance before treatment. The size of the metastasis was proportionate to the extent of the primary tumor, but at times small lingual lesions coexist with large lymph nodes and advanced lingual growths exist without metastases to lymph nodes. Lymph nodes exceeding 3 cm. were unusual when the primary lesion occurred in the anterior half of the tongue; nodes of this size occurred in 13 per cent of the cases of epithelioma of dorsum and edges, and 32 per cent of the cases of epithelioma of the posterior third of the tongue.

Methods of Treatment. Radium puncture with removable radium needles alone or associated with other treatments has been used in 785 cases. It was used alone in 176 cases (16 in group a, 139 in group b, 21 in group c).

It was combined with intraoral mold in 3 cases of the anterior third of the tongue and with intraoral and cervical mold in 6 cases of the same primary location.

It was combined with cervical mold in 221 cases (21 in group a, 140 in group b, 60 in group c).

It was combined with external roentgen therapy in 15 cases (2 in group a, 1 in group b, 12 in group c).

It is of interest to note that intraoral roentgen therapy has been used in only one case during the period 1919–1941.

Radium puncture was associated with block dissection of the neck in 362 cases (lymph nodes were invaded in 228, or 68 per cent, cases). The operation was followed by the application of a radium mold, roentgen therapy or teleradium in 50 of the cases where lymph nodes were cancerous and in 4 of the cases where the lymph nodes were not cancerous.

The technique of external irradiation varied greatly. At first, a radium mold of columbia paste was used at a distance of 3 cm. That distance has been successively increased to 4, 5, 6, and 7 cm. From 1927 to 1934, large apparatus was used with 1 gram of radium element at a distance of 8

cm. Later, the treatment consisted of teleradium therapy at 8 cm., with 2 grams of radium element and finally at 10 cm. with 3 grams of radium element.

Since 1934 external irradiation has been rarely used in the treatment of secondary lymph nodes in cases of epithelioma of the tongue, for its efficiency has not been clearly demonstrated and at times it has been followed by serious complications. At present it is used only for large, inoperable adenopathies and some of the postoperative recurrences.

From 1934 the treatment of secondary lymph nodes has been mainly surgical in the cases of epithelioma of the movable part of the tongue (group a and b). Since 1936 block dissection has been systematically practiced for lesions of the anterior two-thirds of the tongue, even in the absence of palpable lymph nodes. Operation is not indicated for large adenopathies or in cases of aged or ailing patients.

Radium Puncture of the Tongue. Attempts at interstitial therapy with "glass seeds" were made, unsuccessfully, in 1919 and 1920 for 5 patients. Since 1920 that technique has been discarded.

All the other radium punctures were made with removable platinum needles. A filtration of 0.3 mm. platinum and 0.4 mm. platinum was used from 1919 to 1922. Since 1922 the filtration has always been 0.5 mm. of platinum. First, the length of the needles was 18 mm., 20 mm., 25 mm., 30 mm., 35 mm., and 50 mm., and they contained one, two, three or four glass radon tubes of 0.8 to 1.5 millicuries.

Since 1930, we have needles in platinum with a wall 0.5 mm. thick containing cells of radium element. The lengths are 25, 30 and 35 mm. The two series most frequently used are:

a. Needles of 35 mm. length containing 2 cells of 0.66 mg. radium element, measuring 12 mm., placed one after the other in the lumen of the needles. The total active length is 25 mm. (0.52 mg. radium element per cm.).

b. Needles of 25 mm. length containing one cell of 0.72 mg. radium element, measuring 15 mm. (0.48 radium element per cm.).

These two series have been chosen because they allow the necessary dose to be given in seven, eight or nine days without intensive reaction of the mucosa.

Radon needles are still in use but only in special cases, such as irradiation of the posterior part of the tongue with needles measuring 50 mm. and containing three or four glass tubes of radon. The active length is a little less than the length of the needle.

The implantation of needles is preceded by careful dental examination; bad teeth are extracted and sometimes pyorrhea is treated by vaccine.

A plan of implantation of the needles is made for each patient. The volume to be irradiated includes an area of 8 or 10 mm. beyond the clinically evident border of the infiltration. Most frequently the needles are placed on two parallel planes 10 mm. from each other; for widespread tumors it is necessary to use three or four planes separated by 11, 12 or 13 mm. The peripheral needles are separated by 10 mm. and the central ones by 11, 12 or 13 mm.

It is not always easy to follow exactly the plan designed. It often happens that during the implantation of the needles, the deep infiltration proves more extensive than expected or it may not be possible to implant or suture the needles in correct position.

Tumors of the dorsum and edges are more easily treated when they are not too large. Experience has shown that it is impossible to use more than fifteen or sixteen needles and that extensive tumors cannot be successfully treated by radium puncture alone.

Tumors of the tip of the tongue are very irregular and accurate placement of the needles is difficult, it is safer to do the implantation in two stages. In a first application of four days the needles are placed in a chosen pattern; then, after a period of rest, the needles are re-implanted in a second pattern so as to deliver a homogeneous dose to all parts of the tumor.

Needles are not easily placed in tumors of the posterior part of the tongue and the radium puncture alone can be used only in small lesions. For these locations we sometimes use needles of 50 mm. of length in order to go as far back as possible.

The doses delivered were:

10 to 12 millicuries-destroyed (1,330 to 1,596 milligram-hours) for the Stage I tumors.

15 to 20 millicuries-destroyed (1,995 to 2,660 milligram-hours) for the Stage II and III tumors.

20 to 28 millicuries-destroyed (2,660 to 3,724 milligram-hours) for the Stage IV tumors.

The doses calculated from the table of Quimby for interstitial radiation varied from 6,000 gamma roentgens (r_γ) for the large tumors to 8,000 r_γ and sometimes 8,500 r_γ for the small tumors.

Results of the Treatment. The results will be given successively for the three sites of disease.

1. Anterior third of the tongue (tip and under surface).

Results after five years:

86 patients treated (8, Stage I; 21, Stage II; 37, Stage III; 20, Stage IV).

13 (15 per cent) patients were alive and cured after 5 years.

3 patients were alive but not cured 5 years after treatment.

58 (67 per cent) were dead of the evolution of cancer.

5 were dead of intercurrent disease.

7 were dead of complications due to treatment.

The rate of cure at the different stages of the primary lesions was: Stage I, 50 per cent (4 of 8 cases); Stage II, 19 per cent (4 of 21 cases); Stage III, 8.3 per cent (3 of 37 cases); and Stage IV, 10 per cent (2 of 20 cases).

The rate of cure at the different stages of lymph node involvement was: Stage I, 16 per cent (7 of 42 cases); Stage II, 15 per cent (6 of 40 cases); and Stage III (0 of 4 cases).

Among the patients not cured, the failure was due to both the evolution of the primary lesion and of the lymph nodes in 48 cases (55 per cent), to the evolution of the primary lesion alone in 5 cases (5.8 per cent), to the evolution of the lymph nodes alone, the tongue being cured in 8 cases (9 per cent). Complications due to the treatment caused the death of 7 patients: 2 died of pulmonary infection, 2 died as a result of intense mucous and cutaneous reactions, 1 died of abscess of the floor of the mouth after application of a radium hold, 2 died of complications after surgery for a lingual recurrence and after neck dissection.

The survival of the patients not cured varied from one month to one year in 55 per cent (49 of 84) cases, from two to three years in 11 per cent (10 to 84) cases. One patient is living but he has two slowly growing recurrences.

The results according to the methods of treatment are as follows: By radium puncture alone 1 of 16 patients was cured, by radium puncture combined with cervical mold 6 of 24 patients were cured, by radium puncture combined with cervical and intraoral mold 1 of 6 patients was cured, by radium puncture and block dissection of the neck (non-cancerous lymph nodes) 4 of 8 patients were cured, by radium puncture and block dissection of the neck (cancerous lymph nodes) followed by irradiation with cervical and intraoral mold 1 of 4 patients was cured, of 16 cases treated by radium puncture combined with block dissection of the neck (cancerous lymph nodes), none were cured, and 9 of these had irradiation of the neck after surgery. Of 10 treated by roentgen, therapy alone, none were cured, of 2 by radium puncture and roentgen therapy, none were cured, of 3 treated by intraoral mold, none were cured.

Results after five to twenty-five years:

Among the 13 patients cured after five years, 4 are at present alive and well after twenty-five years, fifteen years, thirteen years and eleven years. The first, aged sixty-nine years, was treated in 1923 by simultaneous intraoral and cervical mold irradiation during the radium puncture for a Stage IV tongue tumor. Radionecrosis

has necessitated amputation of nearly all the movable part of the tongue. The second, with a Stage I primary lesion was treated by radium puncture in two stages and block dissection of the neck (all the lymph nodes were free of cancer). The third, with a Stage I primary lesion, was treated by radium puncture alone in 1935 and is at present cured without sequelae. The fourth, with a Stage III primary lesion, was treated by radium puncture in two stages and block dissection of the neck (lymph nodes free from cancer) and is cured after a slight necrosis of the tip of the tongue.

Five patients died after twenty-two, nineteen, fourteen, twelve and six years of intercurrent disease (4 of heart failure, 1 of acute bronchitis). They were aged eighty-three, sixty-nine, seventy-five, seventy-six and sixty-one years.

Three recurrences in situ without metastatic nodes appeared after fourteen and a half, thirteen and ten years and a new treatment was impossible. A fourth patient developed a recurrence immediately behind the first lesion after six years. This responded to radium puncture but the patient died thirty months later of rapidly growing metastases to secondary lymph nodes.

2. Anterior two-thirds of the tongue (edges and dorsum).

Results after five years:

638 patients treated (121, Stage I; 264, Stage II; 185, Stage III; 61, Stage IV; 7, secondary lymph node cases).

135 (21 per cent) were alive and cured after 5 years.

14 (2 per cent) were alive but not cured after 5 years.

387 (60 per cent) were dead of evolution of cancer after less than 5 years.

14 (2 per cent) were lost to follow-up after less than 5 years.

53 (8.3 per cent) were dead of intercurrent disease.

35 (5.4 per cent) were dead of complications due to treatment.

The rate of cure at the different stages of the primary lesions was: Stage I, 46 per cent (56 of 121 cases); Stage II, 22 per cent (59 of 264 cases); Stage III, 8 per cent (15 of 185 cases); and Stage IV, 6 per cent (4 of 61 cases).

There rate of cure at the different clinical stages of lymph node involvement was: Stage I, 31 per cent (108 of 335 cases); Stage II, 10 per cent (24 of 119 cases); Stage III, 3 per cent (2 of 68 cases; and Stage IV (1 of 16 cases). This was a large cervical adenopathy treated by surgery and irradiation with a mold.

The 401 failures were due to the evolution of both primary lesion and secondary lymph nodes in 284 cases (44 per cent), to recurrences in the tongue alone in 25 cases (4 per cent), to the development of sarcomas in the area treated by radium puncture in 2 cases, and to recurrences in cervical lymph nodes, the tongue being cured in 90 cases (14 per cent).

Complications due to treatment caused death in 35 patients; 13 died of various accidents such as syncope, edema of the glottis, aphasia and hemiplegia, hemorrhage, from a few hours to ten or fifteen days after block dissection of the neck. Two died after surgery for tongue recurrences, 4 died during or immediately after the radium puncture (2 heart failures, 1 abscess of the floor of the mouth, 1 hyperpyrexia); 16 patients died of intensive cutaneous and mucous reaction after external irradiation by radium mold (6 cases), roentgen therapy (7 cases) and teleradium therapy (3 cases).

The results according to the method of treatment are as follows: by radium puncture alone 34 of 139 patients were cured (24 per cent). These included not only early cases but also aged patients in bad general health for whom it was impossible to do anything else.

Of 140 patients treated by radium puncture combined with external irradiation by radium mold, 27 (18 per cent) were cured.

Radium puncture followed by block dissection of the neck when the lymph nodes were histopathologically free from cancer gave 45 cures of 110 patients (40 per cent);

and when the lymph nodes were histopathologically cancerous this treatment gave 29 cures of 171 patients (16 per cent).

For most of the patients operated upon between 1924 and 1934, surgery was followed by external irradiation with radium mold or teleradium. Since 1934 these methods of irradiation have been discontinued and the rate of cure has been nearly the same, 16 per cent in the first period, 17 per cent in the second period.

External irradiation by roentgen therapy or teleradium alone did not cure any of the 78 patients so treated and gave only some transient regression or healing.

Of the patients who were not cured, 60 per cent survived less than one year but instances of long survival were observed; 14 patients developed successive local recurrences and died after six to eleven years. It has been possible to delay the progress of the disease by repeated radium punctures or electrocoagulations.

Results after ten, fifteen and twenty years.

Among the 558 patients treated from 1919 to 1938, the following results were obtained:

After 5 years

122 (21 per cent) were alive and cured.
14 were alive but not cured.
358 were dead of cancer.
52 were dead of intercurrent disease.
12 were lost to follow-up.

After 10 years

80 (14 per cent) were alive and cured.
4 were alive but with recurrences.
383 were dead of cancer.
74 were dead of intercurrent disease.
17 were lost to follow-up.

If we consider only the 414 patients treated from 1919 to 1933, the end results are as follows:

85 cured after 5 years (21 per cent).
53 cured after 10 years (13 per cent).
14 cured after 15 years (3 per cent).

Among the 265 patients treated from 1919 to 1928, 6 (2.2 per cent) are alive and cured after twenty years.

Fate of the patients cured after more than five years.

Among the 135 patients alive and cured after five years:

48 (35 per cent) are alive and cured after 7 to 26 years.
46 (34 per cent) died of intercurrent disease after 6 to 20 years.
32 (22 per cent) developed recurrences after 6 to 20 years.
10 (7 per cent) were lost to follow-up after 6 to 20 years.

Among the 48 patients alive and cured after five years, 1 is alive and well after twenty-six years, 2 after twenty-two years, 2 after twenty years, 2 after nineteen years, 1 after eighteen years, 1 after seventeen years, 2 after sixteen years, 3 after fifteen years, 3 after fourteen years, 6 after thirteen years, 5 after twelve years, 7 after eleven years, 3 after ten years, 2 after nine years, 4 after eight years and 3 after seven years.

The first patient had a Stage 1 primary tumor without palpable lymph nodes; she was treated in 1922 by an intraoral radium mold during the radium puncture. She was cured without sequelae.

The second patient with a Stage 1 primary tumor, without palpable lymph nodes, was irradiated in 1923 by a cervical radium mold during the radium puncture and is cured. He developed an osteonecrosis of the mandible one year after treatment; eighteen months later the sequestrum was spontaneously discharged and complete healing occurred. The buccal mucosa is nearly normal but there is a marked scleroderma with retraction of the skin fixed to the remnants of the mandible.

Alive and cured without sequelae are 29 other patients who were treated between 1925 and 1936; 8 were treated by radium puncture alone, 4 by radium puncture and external irradiation, 17 by radium puncture and block dissection of the neck combined at times with external irradiation.

The 17 remaining patients are alive and cured without sequelae. There were treated between 1937 and 1941 by radium puncture of the tongue nad systematic block dissection of the neck.

Late recurrences. Late recurrences appeared after six to twenty years in 31 cases.

In 2 patients, recurrences developed after eight years but we have been unable to obtain direct information.

In 23 patients, recurrences developed in situ or in close proximity to the implanted area. There were no lymph nodes in 15 of these cases; lymph nodes were present in 4 cases with rapid extension in 1 of them. In 3 patients lymph nodes appeared after a second and third local recurrence. The last patient is still living with tumor and necrosis progressing slowly, involving the tongue, mandible and cervical lymph nodes and no treatment is available.

In 1 patient, aged eighty-two years, treated by radium puncture of the tongue with a small dose and block dissection of the neck (lymph nodes free from cancer), a sarcoma, histopathologically verified, appeared in the implanted area nine years after irradiation. At present the patient is in good health, ten months after surgical excision of the growth.

One patient, treated by radium puncture and a heavy dose of external irradiation with a radium mold has been cured for twenty years with marked skin changes. After twenty years a squamous cell epithelioma appeared in the injured skin of the neck, it is considered to be due to irradiation.

Four patients died of metastases. One, treated by radium puncture alone, died after fifteen years of generalized cancer, the tongue being apparently cured. Two, treated by radium puncture and block dissection of the neck (lymph nodes free of cancer in 1 case and invaded by cancer in the other), died after six years and nine months, and six years and three months from liver metastasis.

The last, with a Stage II primary lesion and Stage 1 lymph node involvement, treated by radium puncture of the tongue and application of a mold to the neck, died six years and four months later in intrathoracic metastasis.

Among the 23 patients who developed intraoral recurrences, a second treatment was possible in 15 cases and the following results were obtained:

5 were cured.
3 died of post-operative complications.
4 died of cancer after transient regression.
1 aged 83 years was lost to follow-up in 1941, 18 months after electrocoagulation of a small recurrence in situ which developed 6 years after a radium puncture.
1 is alive with a recurrence developing in 1947, 11½ years after treatment, behind the posterior border of the implanted area. An electrocoagulation was without improvement.
1 is alive 3 months after the excision of a small recurrence in situ occurring 8 years after radium puncture combined with a block dissection of the neck (lymph nodes free from cancer).

Recurrences appeared in the 5 cured patients after fifteen, twelve, eleven, ten and five years; they were local without palpable lymph nodes. The second treatment was radium puncture alone in 3 cases, and radium puncture combined with a block dissection of the neck in 2 cases (lymph nodes free from cancer). Three of them died of intercurrent disease seven, ten and eleven years after the second treatment; 1 died after three years of a gastric glandular epithelioma; 1 patient is alive and cured twelve years after the second treatment.

Among the 3 patients who died of post-operative complications, 1 had a block dissection of the neck with ligature of the external carotid and lingual artery and electrocoagulation of the right half of the tongue; the recurrence, discovered after eleven years, was local and the lymph nodes were microscopically free from cancer. The other 2 patients, cured after the excision of a first local recurrence after eleven years, died two years later of secondary hemorrhage after the electrocoagulation of further local recurrences.

Four patients died of cancer. In 1 case it was a first local recurrence with no palpable lymph nodes, eleven years after a radium puncture combined with a block dissection

of the neck (cancerous lymph nodes) and postoperative external irradiation. Local treatment by roentgen therapy was unsuccessful. In 2 cases a first local recurrence with no palpable lymph nodes healed after a second radium puncture but was followed four and two years later by a second local recurrence with bulky adenopathy. The fourth patient has had three successive recurrences; the first after six years was local without palpable lymph nodes and healed with a second radium puncture but reappeared in situ after two years. A surgical excision gave a good result but two years later a third local recurrence with bulky adenopathy was unsuccessfully treated by external irradiation (teleradium).

To sum up, the late recurrences were local alone in 15 cases and local with adenopathy in 8 cases. We never observed late recurrences in lymph nodes only, the tongue being cured. Local recurrences can be treated successfully when they are small and do not invade the lymph nodes. The risks of a second irradiation or of a surgical treatment are considerable when the recurrences are extensive.

3. Posterior third of the tongue.

Results after five years:

331 patients treated (17, Stage I; 84, Stage II; 158, Stage III; 72, Stage IV).
34 (10 per cent) were alive and cured after 5 years.
1 was alive but not cured after 5 years.
270 (80 per cent) were dead of evolution of cancer.
3 (1 per cent) were lost to follow-up.
11 (3.3 per cent) were dead of intercurrent disease.
12 (3.6 per cent) were dead of complications due to treatment.

The rate of cure at the different stages of the primary tumor was: Stage I, 41 per cent (7 of 17 cases); Stage II, 17 per cent (15 of 84 cases); Stage III, 6 per cent (10 of 158 cases); Stage IV, 2.7 per cent (2 of 72 cases).

The rate of cure at the different stages of lymph node involvement was: Stage I, 14.9 per cent (13 of 87 cases); Stage II, 11 per cent (15 of 163 cases); Stage III, 5.6 per cent (5 of 88 cases), and Stage IV, 1 exceptional case cured.

The 271 failures were due to the evolution of both primary tumor and metastatic lymph nodes in 241 cases (72 per cent), to recurrence in the tongue alone in 8 cases (2.4 per cent), to evolution of adenopathy alone in 22 cases (6.4 per cent).

Twelve patients died of complications of treatment: 3 of dysphagia after radium puncture (survival eleven days), of cervical abscess (survival three weeks), of hemorrhage (survival two months). Two patients died six and eight weeks after roentgen therapy of cachexia and intensive cutaneous and mucous reactions. External irradiation by molds was followed by death in 4 cases: 1 syncope, 1 glottic edema, 2 intensive cutaneous and mucous reactions. One patient died of cachexia two months after external irradiation by teleradium. One patient died of dyspnea and hyperpyrexia fifteen hours after a block dissection of the neck and 1 patient died of cachexia six weeks after an electrocoagulation of a recurrence in the posterior third of the tongue preceded by a ligature of external carotid.

The results according to the methods of treatment are as follows: by radium puncture alone 2 of 21 patients were cured, by radium puncture combined with cervical mold 8 of 60 patients were cured, by radium puncture followed by block dissection of the neck when the lymph nodes were microscopically free from cancer 5 of 16 patients were cured, by radium puncture followed by block dissection of the neck when the lymph nodes were cancerous 7 of 37 patients were cured, by radium puncture combined with external roentgen therapy 1 of 2 patients was cured, by radium puncture combined with external teleradium none of 3 patients was cured, by external roentgen therapy alone 10 of 134 patients were cured and by teleradium alone 1 of 48 patients was cured.

Results after five to seventeen years.

Among the 34 patients cured after five years 8 are at present alive and well, 1 after seventeen years, 1 after fourteen years, 3 after twelve years, 1 after eleven years and 2 after nine years.

Sixteen patients died of intercurrent disease; 1 after twenty years, 1 after nineteen years, 1 after eighteen years, 1 after fifteen years, 1 after fourteen years, 2 after thirteen years, 1 after twelve years, 1 after eleven years, 1 after nine years, 3 after eight years, 2 after seven years and 1 after six years.

After six years, 2 patients were lost to follow-up.

Eight patients developed late recurrences. One was treated in 1933 by radium puncture and block dissection of the neck for a Stage I primary tumor with histopathologically cancerous lymph nodes. A local recurrence appeared in 1940 after seven years. He is actually cured eight years after a second radium puncture without sequelae. One patient, treated by radium puncture, died after six years of an esophageal carcinoma which can be considered as a recurrence. One patient was treated in 1937 for an epithelioma of the left side of the posterior third of the tongue by radium puncture and external teleradium followed by a cervical block dissection. The lymph nodes had not been sterilized but the tumor cells showed marked histopathologic changes. In 1946, nine years later, a bulky adenopathy appeared suddenly on the right side of the neck associated with a small recurrence on the right side of the posterior third of the tongue. One patient, irradiated in 1922 by an external mold during the radium puncture, was cured, with marked radiation changes in skin and mucous membrane. Six years later, in 1938, a suspicious growth appeared close to an area of osteoradionecrosis of the mandible; the patient was treated abroad from 1928 to 1937 by repeating scraping and electrocoagulation without recovering and died in 1937. Two patients developed bulky, rapidly growing lymph node recurrences after thirteen years. Both these patients, treated by radium puncture and external irradiation, by mold in one case and roentgen therapy in the other, developed remote metastases in liver and mediastinum after eight years.

General Results. If one considers the results as a whole, it is noted that for the three primary sites of disease the rate of cure is between 40 and 50 per cent for the Stage I primary tumors, between 17 and 22 per cent for the Stage II primary tumors and that practically no cures are achieved with Stage IV tumors.

The presence of cancerous lymph nodes makes the prognosis more grave. The cure rate is between 14 and 31 per cent for Stage I metastatic lymph nodes, from 10 to 15 per cent for Stage II, and practically no cures have been obtained in Stage III. For the anterior two-thirds of the tongue the cure rate is 31 per cent for Stage I and only 10 per cent for Stage II, whereas for the anterior third and posterior third the cure rate is nearly the same, 15 to 16 per cent for Stage I and II to 14 per cent for Stage II.

Lingual tumors without lymph node involvement are more easily cured; if they did not diappear (early recurrences in the tongue only were observed in 5.8 per cent of group a, 4.2 per cent of group b, and 2.4 per cent of group c) they grew slowly and the survival period was three or four years. When they recurred after more than five years, it was almost always without lymph nodes and sometimes a second treatment by radium puncture or surgery brought about a new period of cure.

Lingual tumors with cancerous lymph nodes are more difficult to cure. The early recurrences appear simultaneously in the tongue and lymph nodes on 55 per cent of the group a, 44 per cent of the group b and 72 per cent of the group c cases. Recurrences in the lymph nodes only appear in less than five years. Their onset is nearly always sudden and rapid progression of the disease does not permit efficient treatment.

The Use of Radium Puncture in the Series. Among the 1,055 patients reviewed 785 (76 group a, 560 group b, 149 group c) have been treated by radium puncture alone or combined with other methods of treatment. The rate of cure has been: 17 per cent of group a (13 of 75 patients), 24 per cent of group b (135 of 560 patients), and 15 per cent of group c (23 of 149 patients), instead of 15, 21 and 10 per cent when the 1,055 patients are reviewed as a whole.

Radium puncture was the sole treatment in 175 cases; it was combined with the use of a radium mold in 230 cases (221 external irradiation and 8 intraoral irradiation).

Radium puncture was associated with external irradiation by roentgen rays in 15 cases and by teleradium in 3 cases.

Radium puncture was followed by block dissection of the neck in 362 cases.

Radium puncture alone: 175 cases.

The radium puncture alone gave 21 per cent cures (37 of 175 patients). It was used not only in early cases but also when any other treatment was contraindicated by age or bad general health. In some cases of extensive primary tumors with no apparent lymph node involvement, the implantation of needles was only palliative and gave transient and sometimes surprising improvement.

The best results, 24 per cent (34 of 138 cases), were obtained in lesions of the dorsum and edges of the tongue where conditions are better for correct implantation of the needles.

The results are bad for the tip of the tongue (1 of 16 cases) and for the pharyngeal part (2 of 21 cases) because in these sites technical conditions are unfavorable.

Radium puncture combined with irradiation by radium mold: 230 cases.

This combination gave 18.2 per cent (42 of 230 cases) cures. It is difficult to appreciate the part played by the radium mold. When compared with the results obtained by radium puncture alone, the combined treatment showed some improvement in group a 23 per cent (7 of 30 cases) and in group c 13 per cent (8 of 60 cases), but there was no improvement in group b.

It may be assumed that the intraoral mold completed the irradiation by needles in cases of tumors of the tip of the tongue and that the external molds acted on the radiosensitive lymph nodes secondary to tumors of the posterior third of the tongue.

Radium puncture associated with block dissection of the neck: 362 cases.

It is in this series that the best results were obtained with an over-all cure rate of 25 per cent (91 of 362 cases). The cure rate was 40.3 per cent (54 of 134 cases) where the nodes were free from cancer, and 16 per cent (37 of 228 cases) where the lymph nodes were cancerous.

This can be explained partly by the fact that in the operated patients the primary tumor was generally of small or moderate size; but in the cases of cancerous lymph nodes 37 patients were cured by surgery. It is interesting to observe that among the 171 patients operated upon in group b, the block dissection of the neck was bilateral in 26 cases, and that out of the 20 cases of histopathologically bilateral cancerous lymph nodes, 4 cures were obtained.

Radium puncture combined with external roentgen therapy: 15 cases.

One of the 15 cases was treated in 1919 for a Stage I tumor of the tip of the tongue by radium puncture combined with intraoral roentgen therapy. The tongue healed but after one year a recurrence appeared in situ with rapidly growing adenopathy.

For the 14 remaining patients the tumor was located in the posterior third of the tongue; only one of them was cured and this patient died after eight years of distant metastases.

Radium puncture associated with teletherapy: 3 cases.

This method was used in Stage II, III and IV cases of primary tumor with Stage III adenopathy. Only transient improvement was obtained with eight, eighteen and nineteen months of survival.

CONCLUSIONS

The treatment of cancer of the tongue has been carried out mainly by the use of radium needles placed in and around the tumor.

The results obtained have been best in the group where the tumor arose either on the dorsum or lateral borders of the tongue, and less satisfactory where lesions occurred on the tip, infralingual region and the base of the tongue.

External irradiation by radium molds, telecurietherapy and roentgen therapy added to radium puncture have not appreciably improved the results.

Block dissection of the neck, performed routinely since 1936 for lesions on the movable part of the tongue, was done in 362 cases and a number of them with metastatic lymph nodes were thus cured.

The outcome depended on the location and the extent of the cancer, and the presence of metastatic lymph nodes increased the difficulty of treatment.

Late recurrences were observed after six to twenty years: 30 per cent in group a (4 of 13 cases), 23 per cent in group b (31 of 135 cases) and 23 per cent in group c (8 of 34 cases). They were more frequently local alone, sometimes in the tongue and lymph nodes, but never in the lymph nodes alone.

Curie Foundation
Paris, France

END RESULTS OF TREATMENT OF CANCER OF THE TONGUE*

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DURING the period covering the years from 1909 to 1915, a simple technique was used at Radiumhemmet in the treatment of cancer of the tongue. At that time the radium preparations were pressed against the tumor while treatment was in progress. With the introduction of dental plastic mass for fixation of the radium tubes (1915) this technique was greatly refined. Until 1922 we used surface radium application in the treatment of primary tumors combined with roentgen rays to the glandular region. In 1921, I studied at the Memorial Hospital in New York. It was there I became acquainted with the technique of interstitial implantation with glass (bare) tubes and gold needles which were introduced by Janeway and Quick. I also saw there for the first time teleradium treatment in the form of packs and the use of electroendothermy as a complement to radium treatment.

Back in Sweden, I introduced this type of teleradium treatment. In 1922, Lysholm devised a special apparatus for teleradium treatment, and in 1929, Sievert devised the teleradium apparatus which, though somewhat modified, is still used in Radiumhemmet.

We have now two teleradium apparatuses, one containing 3 grams and the other 5 grams of radium, total filter equivalent to 6 mm. of lead. The treatment field is circular with a diameter of 5 cm. Radium skin distance is 6 cm.

Since 1931 we have been treating carcinomas of the tongue largely by the technique described below.

Oral hygiene is the first consideration to avoid an osteomyelitis or a radionecrosis from infection later on.

The teleradium treatment is given through five or more portals, the distance between their centers being from about 6 to 7 cm. The portals must be arranged in such a way that both the primary tumor and the lymph node bearing area are included. We use two portals on the primary tumor, one portal on the upper deep cervical group of lymph nodes, one on the submaxillary triangle and one on the nodes in the supraclavicular region. It would appear that metastases invade the upper deep cervical lymph nodes first.

We distribute about 4,000–4,500 gamma roentgens (r_γ) on each field. We give one treatment daily, namely about 1,000 r_γ skin dose over one and a half to two hours, 9–11 r_γ per minute. The tumor dose given to the primary tumor is about 5,000–5,500 r_γ which is applied over fifteen to twenty days. This dosage produces a typical exudative dermatitis of the skin as well as a typical epithelitis on the tumor side of the tongue corresponding to an epidermicide and an epithelicide effect on the normal cells.

Two to three months after treatment it is possible to assess its effect. In most cases there is a small remnant of the primary tumor. This remnant is treated by electroendothermy with bipolar coagulation of the tumor.

Radical block dissection of the glandular region by Crile's method is performed either in cases where clinical metastases are present or where such have developed later.

In the earlier period covering the years from 1921 to 1923, we used, as I have mentioned in the beginning of this paper, application of radium tubes to the surface of the tumor with the help of plastic mass, or

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interstitial implantation of radium needles and external roentgen treatment, or teleradium treatment by applying a small quantity of radium to the glandular region.

During these years we observed 178 cases (Table I). Forty-two of them, or 24 per cent, were too advanced for treatment. The total number of patients treated was thus 136. Sixty-five of these patients had

TABLE I

RESULTS OF TREATMENT OF CANCER OF THE TONGUE (CASES ADMITTED 1921–1930)

Total number of patients seen (42+136)		178
Total number of patients treated		136
Indeterminate group		
Dead as a result of other causes and without recurrence	9	
Lost track of and without recurrence	0	
Total number of indeterminate results		9
Determinate group		
Total number minus those of indeterminate group		127
Failures		
Dead as a result of cancer or living with recurrence	100	
Lost track of	0	
Total number of failures in treatment		100
Successful results		
Free from disease after 5 years or more		27
Five year end results		
Successful results divided by determinate group (acc. Memorial Hosp.)		21.3%
Relative cure (27 of 136 cases)		19.9%
Absolute cure (27 of 178 cases)		15.2%

clinical metastases on admission. Nine patients died from causes other than cancer. They have been classed under the heading indeterminate group in accordance with the principles suggested by the Memorial Hospital.

Thus 127 cases are left which form the determinate group. One hundred of these died of cancer or lived with recurrence after five years. Thus 27, or 21.3 per cent, are free from disease after a follow-up time of five years or longer.

If I add the 9 patients of the indeterminate group (on the principles laid down by the Health Commission of the League of Nations) I have a total of 136 cases. Of these 27 are free from symptoms five years or more, giving a relative cure of 19.9 per cent. If the total of patients seen—altogether 178—is taken into account, the rate of absolute cure is 15.2 per cent.

During the years from 1931 to 1942, 302

TABLE II

RESULTS OF TREATMENT OF CANCER OF THE TONGUE (CASES ADMITTED 1931–1942)

Total number of patients seen (35+267)		302
Total number of patients treated		267
Indeterminate group		
Dead as a result of other causes and without recurrence	25	
Lost track of and without recurrence	0	
Total number of indeterminate results		25
Determinate group		
Total number minus those of indeterminate group		242
Failures		
Dead as a result of cancer or living with recurrence	167	
Lost track of	0	
Total number of failures in treatment		167
Successful results		
Free from disease after 5 years or more		75
Five year end results		
Successful results divided by determinate group (acc. Memorial Hosp.)		31.0%
Relative cure (75 of 267 cases)		28.1%*
Absolute cure (75 of 302 cases)		24.8%

cases of carcinoma of the tongue have been examined at Radiumhemmet (Table II). In 35 of these cases (12 per cent) the patients were in too poor general condition and the disease too advanced for treatment. Consequently the total number of patients treated is 267. In 60 per cent of these the patients had on admission clinical metastases. Of these 267 patients, 25 died of in-

* As this paper was written in 1948 and the cure rate has risen during the last years, even though the proportion of advanced cases has increased in the material, the author wishes to add the relative five year cure rate for patients admitted 1938–1944 = 34 per cent (57 of 168 patients free from signs and symptoms five years or more).

tercurrent disease without any signs or symptoms of recurrence. I have, in accordance with the principles of the Memorial Hospital, classified them as an indeterminate group. No patient is untraced.

The remaining 242 patients constitute the determinate group. One hundred and sixty-seven patients died of cancer or were alive with recurrence at the end of the fifth year after treatment. Hence, the cases rate, 29.1 per cent and the fifteen year survival rate, 29.1 per cent (Table III).

Different factors influence the five year cure results, namely:

A. Age. Before the age of sixty years the rate of five year cure is about 35 per cent (relative cure). Between the age of sixty and eighty years it is about 25 per cent. After the age of eighty years there is no five year cure. The power of very old people

TABLE III

CANCER OF THE TONGUE (CASES ADMITTED 1931–1942)

Calculation of the 5 year *Survival* rate

Total No. of patients seen: 302. Total No. of patients treated: 267

Period from Treatment	Patients Entering the Period	Patients Passing Out of Observation During the Period			Average No. of Patients Under Observation	No. of Cancer Deaths	Cancer Mortality (per cent)	Survivors in Each Period (per cent)	Survival Rate (per cent)
		Intercurrent deaths	Lost track of	Not yet observed for the whole period					
0– 1 yr.	267	11	0	0	261.5	121	46.3	53.7	53.7
1– 2 yr.	135	4	0	0	133	31	23.3	76.7	41.2
2– 3 yr.	100	2	0	0	99	9	9.1	90.5	37.3
3– 4 yr.	89	4	0	0	76	4	4.6	95.4	35.6
4– 5 yr.	81	3	0	0	79.5	1	1.2	98.8	35.2
5– 6 yr.	77	6	0	7	74	1	1.4	98.6	34.7
6– 7 yr.	63	3	0	6	58.5	3	5.1	94.9	32.9
7– 8 yr.	51	3	0	8	45.5	1	2.2	97.8	32.2
8– 9 yr.	39	3	0	5	35	2	5.7	94.3	30.4
9–10 yr.	29	2	0	3	26.5	0	0	100.0	30.4
10–11 yr.	24	1	0	0	23.5	1	4.2	95.8	29.1
11–12 yr.	22	0	0	0	22	0	0	100.0	29.1
12–13 yr.	22	3	0	3	19	0	0	100.0	29.1
13–14 yr.	16	0	0	0	16	0	0	100.0	29.1
14–15 yr.	16	0	0	0	16	0	0	100.0	29.1
More than 15 yr.	16								

where treatment was a failure total 167. Seventy-five patients were free from disease five years or longer after treatment, the percentage of cure being 31 per cent.

If I calculate the rate of cure in the total of the cases seen, in accordance with the principles of statistics laid down by the Health Commission of the League of Nations, the rate of five year cure is 24.8 per cent (absolute cure). The relative five year cure is 28.1 per cent.

The five year survival rate among the 267 cases treated, if calculated on the basis of the form suggested by Memorial Hospital, is 34.7 per cent, the ten year *survival* to react to treatment seems, locally as well as generally, to be markedly reduced.

B. Sex. In the cases observed at Radiumhemmet the five year cure rate in women is higher than in men: in the former it is 34 per cent, in the latter it is 27 per cent.

C. Sideropenia. In 30 cases with signs and symptoms of sideropenia the five year relative cure rate is 33 per cent which corresponds to that found in the total of the cases treated. Hence, sideropenia does not seem to influence the healing process.

D. Syphilis. In 37 cases in whom the patients on admission gave a history of either syphilis or a positive Wassermann

reaction, or both, the relative five year cure rate was only 14 per cent. The prognosis in the cases with syphilis is bad owing to the impaired resistance of the luetic tissues with their bad nutrition and resorption conditions.

E. The Site of the Primary Tumor. According to our findings there does not seem to exist any relationship between the cure rate and the different localizations of the tumor within the region of the *anterior part* of the tongue. In this region there is, as a rule, good primary healing, 30 per cent five year relative cure. In contrast to this the prognosis in tumors localized to the *base* of the tongue is very bad, the five year relative cure being only 12 per cent.

F. Size and Extent of the Primary Tumor. In small primary tumors confined to the tongue with a maximum diameter of 3 cm. and without metastases on admission, the five year relative cure rate is 65 per cent (probably corresponding to Cade's "early cases"). In larger tumors and tumors extended to adjacent tissues the five year cure drops down to only 15 per cent.

G. Presence of Metastases. If clinical metastases are found in a patient on admission, this plays a very important part in the prognosis. The incidence of clinical metastases in my series is about 60 per cent. The clinical staging is difficult and uncertain. According to my experience about 25 per cent of cases classified as Stage I on admission develop metastases sooner or later (34 of 136 cases). On the other hand, about 20 per cent of cases operated upon with block dissection, classified as Stage II, show no microscopic malignancy. Even an aspiration biopsy or extirpation of *one* lymph node is not sufficient for an adequate diagnosis of malignancy or not. My experience is that metastases in some cases develop rather soon even if biopsy has shown no malignancy. In my series of 103 cases with no clinical metastases on admission or later (clinical Stage I) there is a five year relative cure of 52 per cent. In 130 cases with metastases on admission (Stage II) the five year relative cure is 15 per cent. Thirty-four cases, which developed metastases after admission, have only a 6 per cent five year cure.

The effect of the radiation treatment on clinical metastases is illustrated by the fact that 4 cases presenting inoperable metastases on admission were amenable to surgical treatment after radiotherapy. Only 24 cases with clinical metastases have been operated upon, using the method of block dissection (Crile). In 3 of these cases the cancer cells showed, according to the pathological report, marked degeneration, and it was therefore assumed that they were incapable of further growth.

The method used at Radiumhemmet—teleradium plus electrocoagulation to the primary tumor—teleradium in suitable cases combined with surgery, to the glandular region—seems to give a fairly good cure of the primary tumor. In cases belonging to Stage II a more active use of radical surgery may possibly improve the results.

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TREATMENT OF CANCER OF THE TONGUE*

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THIS report is based on the study of 365 cases of cancer of the tongue in a series of a total of 550 cases of malignant lesions of the mouth. It covers a period of twenty-five years. It includes the 1939–1945 period when I was absent on war service and this period has considerably affected the follow-up of cases and the statistical survey results. It is computed that in England and Wales, 1,000 persons die every year from cancer of the tongue. On the presumption that for every death there are 3 cases alive with the disease, this brings the total incidence to only 75 cases of cancer of the tongue per million people living. It is therefore necessary to concentrate these patients in as few centers as possible, or the individual experience of the surgeon or radiotherapist becomes negligible.

DIAGNOSIS

It must be emphasized that a good deal of time is lost before a diagnosis is established; the delay in most cases is due to lack of appreciation that the commonest persistent lesion of the tongue is a cancer and that a positive Wassermann test does not exclude it. Benign and inflammatory lesions can mimic cancer, but the reverse is not true. Biopsy, if adequate, establishes the diagnosis and should not be delayed.

CHOICE OF METHOD OF TREATMENT

The treatment of choice is radium; in about 7 per cent of cases, surgical excision is indicated and this small group includes the following: (1) where the disease has spread to the floor of the mouth and involved the mandible; (2) where the entire tongue is involved in its anterior part down to the V of the circumvallate papillae by a hard infiltrating growth; (3) in cases which have failed to respond to irradiation, either as an immediate failure with but slight regression of the lesion or when recurrence of active disease takes place within a few months of treatment. If surgery is decided on, ablation of the requisite part of the tongue and adjoining tissue is preferably done by diathermy; if the alveolus is involved, part of the mandible is resected.

RADIUM THERAPY

Two methods of radium therapy are employed at Westminster Hospital for cancer of the tongue. Their choice depends solely on the site of the lesion.

For lesions of the anterior part of the tongue insertion of radium needles is the method of choice. In lesions of the vallecula, epiglottis, glossopalatine folds, or in the posterolateral group spreading to the alveolar mucosa or palate, teleradium is used. Roentgen therapy as the sole method of treatment in cancer of the tongue is disappointing although as an additional source of radiation in cases treated by teleradium, it has proved useful. In both types of cases and in superficial lesions of the floor of the mouth or palate, intraoral plaques (molds) are occasionally used to supplement needling or teleradium; especially in cases where, at the junction of the tongue and upper or lower alveolus or the palate, uniform distribution of radiation and an adequate dose are difficult or impossible to achieve by other means.

DISTRIBUTION OF RADIATION AND DOSAGE

To obtain a homogeneous distribution of radiation in the lesion and surrounding tissue, to assess the quantity of radium needed, and to determine the dose from a given

* Presented in a panel discussion on End Results of Treatment of Cancer of the Tongue at the Thirtieth Annual Meeting, American Radium Society, Chicago, Ill., June 20–22, 1948.

arrangement of needles, the cooperation of a clinically trained physicist is a primary essential. Without such cooperation radium therapy is empirical and there is no control over the efficacy of the irradiation. The dosage rate, the total time of treatment and the estimation of degree of reaction are the clinician's responsibility, and as in other branches of medicine, experience can only be gained by constant practice. The actual insertion of needles or seeds and their retention in the tissues for the desired time require a certain degree of surgical skill. The treatment must be planned and systematic. The lesion in the tongue is of course carefully examined and its extent, position, shape and volume ascertained. The spatial distribution of the needles must fulfill certain physical desiderata and the dosage system devised by Paterson and Parker first for surface application and subsesequently worked out by them for interstitial therapy, remains the simplest, the most useful and generally accepted method. As regards the total dose, it has varied in our cases from 6,000 to 9,000 gamma roentgens delivered in 168 hours; the dosage rate showed an equally wide range from 30 to 75 r_γ per hour. For interstitial treatment an average of seven days is now used.

As regards teleradium, a vast amount of clinical, physical and biological research has been done in the past fifteen years. The magnitude of the task can be illustrated by the problems which the treatment presents: total dose, dosage rate, time of individual treatment, interval between treatments, over-all time of treatment. From the physicist's point of view in the use of beam therapy—the direction of the beam, the combination of multiple ports of entry, and the spatial distribution of radiation are some of the problems. Limitations imposed by the maximum tolerance of the skin, the anatomical configuration of the part traversed by the beam and the position of the lesion are so many added difficulties. To overcome these practical difficulties and to insure an optimum arrangement for the fields in each individual case, H. T. Flint and C. W. Wilson have constructed suitable frameworks or "jigs" for the various parts of the neck which provide the position of the fields and the direction of the beam. Wilson has thus contributed the principle and provided the facilities for placing the patient within a known field of radiation in preference to providing unknown fields within the patient.

Using the present model of the 4 gram radium unit at Westminster Hospital it takes four to six weeks to treat a lesion in the pharyngeal portion of the tongue; two treatments of fifty minutes each are given daily five days a week. The average tissue dosage is between 5,000–6,000 r_γ; the skin reactions are still at times severe, in degree up to desquamation and moist peeling.

TREATMENT OF CERVICAL LYMPH NODES

No method of irradiation can so far compare in adequacy with the surgical removal of the cervical lymph nodes. The wide dissection or "block" dissection associated with the names of Butlin, Crile and later, Roux-Berger, still remains the most certain method of treatment.

The operation should consist in the removal of the deep cervical fascia from the level of the mandible to the clavicle; the sternomastoid muscle; the internal jugular vein, the anterior belly of the omohyoid and often the posterior belly of the digastric are removed, together with the glands in the anterior and submaxillary triangles. It is an operation for the skilled surgeon, and in such hands presents no great risk. The indications for this operation are quite clear-cut: (1) The primary lesion in the tongue should be healed and there must be a reasonable prospect of permanent regression. (2) The glands although palpable and clinically malignant should be mobile or only slightly adherent; they must be not only "removable" but strictly operable. (3) The general health of the patient should not be such as to preclude a major operation. It is necessary to emphasize that

the operation should not be undertaken unless these conditions prevail. Incomplete removal is doomed to failure.

If a block dissection is deemed unsuitable, irradiation by teleradium and roentgen rays is the second best available. There is, however, a group of cases where interstitial radiation is indicated, when the lymph nodes are matted together and form a hard fixed mass, a two plane or volume implant is indicated. Long radium needles of low intensity, that is 2 or 3 mg. of radium in an over-all length of 6 cm., are inserted into the mass and left in situ seven days. The dose aimed at is 8,000 r_γ. Shrinking of the mass and arrest of the disease for one to two years can thus be achieved.

RESULTS

The results obtained in the series of cases are indicated in the following tables.

TABLE I

CANCER OF THE TONGUE

Total number of cases	365
Indeterminate group	50
Determinate group	315

TABLE II

CANCER OF THE TONGUE

Determinate Group

Dead from cancer	209
Dead from other causes (cancer present)	25
Lost trace of (probably dead)	32
Total number of failures	266
Free from disease	99

Percentage of 5–15 years' survival: 27 per cent all cases; 31 per cent determinate.

TABLE III

CANCER OF TONGUE 1924–1939

	Total	Alive: 5 Years Free of Disease	Per Cent
	220	49	22.3
Anterior	24	5	20.8
Posterior	89	16	17.9
Inferior	37	8	21.6
Lateral	70	20	28.6

TABLE IV

CANCER OF TONGUE 1924–1939

Results in Various Stages

	Total	Alive: 5 Years Free of Disease	Per Cent
	220	49	22.3
Early cases	30	17	56.6
Without glands	60	20	33.3
With glands	130	12	9.2

SUMMARY

1. All cases have histopathological proof of disease (squamous cell carcinoma).
2. The method of treatment is radium needling to the tongue in anterior lesions and teleradium in posterior lesions.
3. Exceptions are:
   (1) When the lesion involves the mandible.
   (2) When the whole tongue is involved.
   (3) When previous radium treatment has failed to cure the lesion. Such cases are treated by surgical excision.
4. Cervical lymph nodes are treated by
   A. Block dissection of the neck.
      (1) When the primary lesion is soundly healed.
      (2) When the lymph nodes are enlarged and strictly operable.
      (3) When the age and general health of the patient permit a major surgical procedure.
   B. By teleradium
      (1) When the primary lesion has not entirely regressed.
      (2) When the lymph nodes are not strictly operable—adherent to deep fascia, etc.
      (3) When the general health does not permit a major procedure.
   C. By interstitial radium
      When there is a fixed mass of lymph nodes.

Westminster Hospital
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END RESULTS AND TREATMENT OF CANCER OF THE TONGUE*

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IT GIVES me great pleasure to take part in this discussion and to present my figures of the results of treatment of cancer of the tongue carried out at the Middlesex Hospital in London in the years 1931–1942. During this period of twelve years 279 patients came to the hospital seeking advice for cancer of the tongue. My figures of cases treated are based on 243 of these patients, 36 having received no treatment either on account of the very advanced stage of their disease or of their refusal to accept the treatment advised.

The five year end results (Table I) drawn up in conformity with the scheme agreed for reporting such results to this meeting are 21.3 per cent for the whole group including growths involving the anterior two-thirds, the posterior third, and the whole tongue.

The ten year end results based on 181 of these patients who came to the hospital in the years 1931–1937 are 13.1 per cent.

Table II shows that the five year end results in cases involving the anterior two-thirds is 29.6 per cent, the posterior third 9.8 per cent and that with involvement of the whole tongue there is only 1 case out of 14, that is 7 per cent.

Analysis of the 144 cases of growth involving the anterior two-thirds (Table III) shows 44.2 per cent in cases in which there were no glands on clinical examination at the beginning of treatment, and 13.8 per cent if glands were present. The posterior third cases (Table IV) show 17.2 per cent

TABLE I

CANCER OF THE TONGUE

Cases Treated, 1931–1942
End Results of Treatment

		1931–1942	1931–1937
All cases		279	181
Indeterminate group	1, 2, 3	36	26
	4	13	14
	5	0	1
Total indeterminate		49	41
Determinate		230	140
Failures	1, 2	179	122
	3	2	0
Total failures		181	122
Successful results			
Free from cancer		5 years or more 49	10 years or more 18
End results		5 year 49/230 = 21.3%	10 year 18/140 = 12.8%

* Presented in a panel discussion on End Results of Treatment of Cancer of the Tongue at the Thirtieth Annual Meeting, American Radium Society, Chicago, Ill., June 20–22, 1948.

TABLE II

CANCER OF THE TONGUE 1931–1942

Five Year End Results

	Anterior Two-Thirds	Posterior Third	Whole Tongue
Cases treated	144	85	14
Indeterminate group			
(4) Died other causes with no recurrence	9	4	0
Determinate group	135	81	14
Failures 1, 2	93	74	13
3	2	0	0
Total failures in treatments	95	74	13
Successful results			
Free from cancer 5 or more years	40	8	1
5 year end results	40/135 = 29.6%	8/81 = 9.8%	1/14 = 7%

TABLE III

CANCER OF THE TONGUE 1931–1942

Anterior Two-Thirds

	All Stages	No Glands	Mobile	Fixed
Cases treated	144	75	54	15
Indeterminate group				
Died of other causes without recurrence	9	5	4	0
Total indeterminate	9	5	4	0
Determinate group	135	70	50	15
Failures 1, 2	93	37	44	12
Untraced 3	2	2	0	0
Total failures in treatment	95	39	44	12
Successful results				
Free from cancer 5 or more years	40	31	6	3
5 year end results	40/135 = 29.6%	31/70 = 44.2%	6/50 = 12%	3/15 = 20%
			9/65 = 13.8%	

with no glands and 5.7 per cent when glands were involved.

It is obvious that in discussion on the treatment of cancer of the tongue there must be a differentiation between cases of the anterior two-thirds and those of the posterior third, and the treatment of the primary lesion is an entirely different prob-

TABLE IV

CANCER OF THE TONGUE 1931–1942

Posterior One-Third

	All Stages	No Glands	Mobile	Fixed
Cases treated	85	32	22	31
Indeterminate group (4)	4	3	1	0
Determinate group	81	29	21	31
Failures (1) (2)	74	24	19	31
Successful results 5 years	8	5	3	0
5 year end results	8/81 = 9.8%	5/29 = 17.2%	3/21 = 14%	0/31
			3/52 = 5.7%	

lem from that of the glandular metastases.

The patients who made up the material from which these figures have been compiled represent an average sample of the patients suffering from cancer of the tongue who come to a general hospital in Great Britain. They make up less than 2 per cent of the total cases of cancer registered in the hospital. This figure is tending to decrease both as regards the incidence of cancer of the tongue relative to other forms of cancer and on account of a real decrease in the occurrence of lingual cancer. There was also a diminution in the numbers treated from 1939 to 1942 owing to dispersal of the population during this part of the war period. The fact that many people had to move at short notice or had their homes destroyed has caused difficulties in follow up. Two patients had been lost within five years of treatment and 3 others are untraced since the seventh, eighth and ninth years after treatment when they were well and free from recurrence.

TREATMENT OF THE PRIMARY GROWTH

The methods of treatment of the primary growth which have been used throughout this series have been fairly uniform and remain the same in principle as those which I use and advocate at the present time. The primary lesion in cancer of the anterior

TABLE V

CANCER OF THE TONGUE 1931–1942

Whole Tongue

	All Stages	No Glands	Mobile	Fixed
Cases treated	14	5	5	4
Determinate group	14	5	5	4
Failures	13	4	5	4
Successful results	1	1	0	0
5 year end results	1/14 = 7%	1/5 = 20%	0	0

two-thirds of the tongue has been treated by the implantation of radium or radon needles in the great majority of cases. In some extensive growths, teleradium was used as a preliminary to needle implantation to clean up the lesion and to simplify the implant.

Primary lesions of the posterior third were treated mainly by teleradium alone, or in some cases a residual ulcer or area of induration remaining after teleradium was treated by the implantation of radium needles.

The place for surgery must remain an important one though its use in the treatment of the primary lesion is limited to a small proportion of the total cases. The indications for its use in this series and in our current practice are (1) cases where there has been recurrence following radiotherapy; (2) some cases where the whole tongue is involved by a diffusely infiltrating growth; (3) cases where cancer has supervened on an area of pre-existing syphilitic glossitis with wooden induration and diminution of blood supply. Such cases do not respond well to radiotherapy and in addition to recurrence are prone to the development of necrosis; (4) cases where the growth has spread across to involve the mandible; (5) growths of a bulky hypertrophic nature, limited to the anterior third of the tongue, which are very difficult if not impossible to treat with an adequate implant.

Roentgen therapy, with a beam generated at 220 kilovolts and half-value layer of 2.1 mm. copper, was used to treat the primary lesion in a small number of cases both of the anterior two-thirds and the the posterior third. It was used in the 1939–1942 period when on account of bombing attacks it was at times difficult and thought to be unsafe to carry on with the use of radium. It was used as a substitute for teleradium as a method of external irradiation and in some early lesions of the anterior two-thirds as a local application by intraoral cone.

The results of roentgen therapy with this quality of beam were not as good as those of teleradium but perhaps the conditions of treatment in those days were not as good as in the former period. There were successes and failures from the local intraoral applications. In my experience the method was applicable with success only to growths which were very limited and easy of access. I am confident that accurate radium implantation can be carried out with success in any tumor of the tongue which is amenable to intraoral roentgen therapy and can be used in a much wider range of lesions.

TREATMENT OF GLANDULAR METASTASES

Patients with no palpable glands have been kept under close observation at frequent and regular follow up. They may, in the case of posterior third growths or extensive tumors in the anterior part of the tongue, have received irradiation of the upper cervical and submaxillary regions during treatment of the primary lesion. Apart from that no treatment has been given specifically to the neck. If glands develop then block dissection of the neck is carried out. Patients who live at a great distance or who for any reason cannot be kept under regular follow up are advised to have a block dissection.

In cases with mobile palpable glands block dissection is now advised as soon as the reaction from the primary treatment has subsided.

In this series of cases a considerable number of patients with metastatic glandular involvement were treated by teleradium in an attempt to assess the value of radiotherapy in cervical glandular metastases. This policy has now been changed in favor of block dissection in cases with palpable glands, which remain mobile and fit for this operation. It is probable that, in the cases which I have reported, the results of the groups with mobile glands would have been improved if this policy of surgical intervention had been adopted throughout.

In cases with fixed and inoperable glands some form of external irradiation has been used as the main method of treatment. Teleradium has been found to be the most

effective agent when the mass of glands has remained fairly localized and when it has not been necessary to irradiate the whole of the neck on both sides. The teleradium unit used at the Middlesex Hospital was in the earlier years a 1 gram unit. This was replaced in 1937 by a unit of 4 grams with pneumatic transference of the radium and of identical design with that which has been described by Miss Wood. The filtration is 1.8 mm. of platinum, the radium skin distance 8.4 cm. and the dosage rate on the surface of the applicator is 427 roentgens per hour. Treatment applicators with field sizes of 4 cm. diameter, 6 by 5 cm. and 8 cm. diameter are interchangeable. It is most suitable for the treatment of cases in which the volume of tissue involved can be covered with a small number of fields. It is necessary with 4 grams to give sessions of fifty minutes to an hour at least once daily to deliver a dose of 6,000–7,000 roentgens over a period of thirty to forty days to a lesion on the back of the tongue or to a fixed glandular mass.

With more widespread involvement, roentgen therapy with a beam quality of 1.5 to 2 mm. copper has been chosen. In cases with extensive disease in both primary and metastatic sites roentgen therapy of this type has been given with relatively small dosage to procure a palliative effect.

In the treatment of a series of cases of cancer of the tongue, as in the treatment of cancer in many other sites, no single method of treatment is appropriate for all cases in all stages of the disease. Surgery and various forms of radiotherapy must be available to be used either alone or in some combination in an individual case. The indications for each are now, however, fairly well established.

The main place for surgery is in the treatment of metastases in the neck. For the primary lesion in the anterior two-thirds of the tongue and as a supplementary treatment in many cases in the posterior third, the implantation of radium needles is by far the most useful and effective method of treatment in the majority of cases. I propose to devote my contribution on treatment to a consideration of this method.

Radium implantation has been used for many years in many clinics throughout the world. It began as an empirical technique. Improvements depended entirely on the clinical observation of patients previously treated and the measure of success attained was a direct reflection of the keenness and the experience gained by an individual worker. Unfortunately, to the casual observer there does not seem to be any great surgical skill required for the implantation of needles, and the treatments in some cases were done in a haphazard manner and left to be carried out at the end of an operating list by a relatively inexperienced assistant. In these conditions the results were bad and the method has in places fallen into disrepute.

In 1934 Paterson and Parker published their "Dosage system for gamma ray therapy," incorporating simple rules for the distribution of radium needles and tubes in surface applications. This was followed in 1938 by "A dosage system for interstitial radium therapy" with similar rules for the implantation of radium needles. This work of Paterson and Parker with its simple distribution rules has formed the basis of radium therapy in Great Britain for the last ten to twelve years and has undoubtedly caused a considerable improvement in the general standard of work and of the results obtained. The basis of the work as far as interstitial therapy is concerned is that the implant should be so arranged that the dose delivered is as homogeneous as possible and can be calculated or measured with a considerable degree of accuracy. Two separate types of implantation were developed:

(1) *Planar Implants.* In these the radium is arranged either as a single plane of needles or seeds or as multiple parallel planes.

(2) *Volume Implants.* These were developed for those cases in which the volume of tissue to be treated could not be dealt with by a planar implant. By the use of the

dosage tables and rules a satisfactory arrangement of radioactive sources can be designed for any specified block of tissue, the whole of which can be implanted.

It may be of advantage to examine these tables and some of the rules of distribution.

Planar Implants. This type of implantation is chosen where it is desired to implant under a tumor spreading along a surface or where a tumor can most easily be dealt with by treating it between two parallel planes of radium, so arranged that the separation of the planes is small, relative to the area of each plane.

The dosage table shows the total amount of radium required to produce 1,000 gamma roentgens at 0.5 cm. from a single plane or in the volume of tissue between two planes. In the case of a single plane the value given by the table is correct on the plane 0.5 cm. distant on either side of the plane of the radium needles. A layer of tissue 1 cm. thick of which the plane of the implanted needles is the center will receive an "effective minimum dose" of 1,000 gamma roentgens.

When the radium is distributed on two planes, the amount found from the tables has to be increased (where the separation of the planes is in excess of 1 cm.) by a factor depending on the distance between the planes. The two plane method is accurate up to a separation distance of 1.5 cm.

Distribution rules for planar implants.

(1) On a single plane the radium should be arranged so that for areas under 25 sq. cm. two-thirds of the radium should be around the periphery of the area and one-third spread evenly over the area itself. Where the area is between 25 and 100 sq. cm. there should be half the radium on the periphery and half over the plane and for areas in excess of 100 sq. cm. there should be one-third on the periphery and two-thirds spread over the area.

(2) A common arrangement will be found to be a row of parallel needles with active ends crossed by means of needles at right angles to the first part of the implant. If it is impossible to cross the ends of such an implant, 10 per cent must be deducted from the area of the plane for table reading purposes, for each "uncrossed" end.

(3) Needles arranged as such a series of parallel lines should not be more than 1 cm. from each other or from the crossing ends.

(4) In two plane implants the radium on each plane should be arranged as in the foregoing rules and the planes should be parallel to each other.

Volume Implants. This method is applicable to those situations in which the tumor is growing in tissue which can be implanted throughout, completely surrounding and impaling the tumor, and where the three dimensions, length, breadth and height, of the volume in question are approximately equal. In practice, in most interstitial work, the volume of tissue to be implanted is usually arranged for convenience of distribution in the form of a cylinder.

The amount of radium expressed in terms of milligram-hours required to produce 1,000 gamma roentgens is read from the "volume" table for the actual volume to be implanted, which must be somewhat in excess of the actual volume of the tumor. The table reading is correct where all dimensions are equal. An addition for "elongation" is made to the table reading, according to the ratio of the longest to the shortest dimension, as shown in the table of "Elongation Factors" given with the dosage table.

Distribution rules for volume implants.

(1) Any volume of tissue may be visualized for distribution purposes as consisting of a "rind" and a "core." The rind for a cylinder consists of a belt and two flat ends. The core is the whole volume of tissue to be irradiated. The total amount of radium determined from the "volume" table is divided into eight parts and in the case of a cylinder is allocated as follows: belt, four parts; core, two parts; each end, one part.

(2) The actual distribution of the radium

is as follows: (a) The radium on each surface (belt, end) should be spaced as evenly possible. (b) The radium for the core should be spread as evenly as possible throughout the volume and should not all be at the center. (c) The number of needles should, if possible, be such that not more than 1.0 to 1.5 cm. of tissue separates any needle from its nearest neighbour. (d) In the cylindrical type of implant the belt should consist of not less than eight needles, the core of not less than four.

(3) In certain types of cylinder implant it is impracticable to close one or both ends of the volume. In such cases the volume as determined by the active length of the belt must be reduced by 7.5 per cent for each "open" end.

These tables and rules, for which I must acknowledge may indebtedness to Dr. Ralston Paterson, will, if closely followed, give an effectively homogenous irradiation of the tissues treated and might therefore at first sight appear to give a short cut to successful implantation. This is by no means true.

It is not easy to implant a series of needles in a block of tissue and keep them exactly parallel and even in the most experienced hands there are many implants which cannot be made to conform exactly to the rules.

The first step in undertaking an implantation is to make an exact estimate of the lesion, its size and its extensions. The treatment is then planned. The place of each needle with its length and strength is mapped out. An adequate margin of apparently normal tissue surrounding the macroscopic disease is included in the volume to be treated. It is wise to provide for a surplus of needles in cases the volume of the tumor may have been underestimated.

Full aseptic surgical technique must be employed and in Great Britain we, almost universally, use general anesthesia. After implantation the needles are sewn in position. There may be some technical problems to be overcome. Some degree of trismus or fixation of the tissues may cause difficulty in introducing the needles into the required position. It may be necessary to pull out the tongue causing elongation of the muscle fibers. When the tongue is returned to its normal position the direction and position of the needles may be altered. The growth may be friable or be deeply ulcerated so that the needles cannot be maintained in the position planned.

When the implant has been completed there may still be some alteration in the relative positions of the needles. Edema of the tongue may occur, causing a widening of the distance between each needle. The retaining threads may slough out of friable tissue causing one or more needles to be displaced.

Even more important than these possibilities is the fact that an implant which has apparently been carried out to the complete satisfaction of the operator may in fact be found on subsequent roentgen examination to have a very poor distribution and that some of the needles may not be at all in the positions that were planned.

It is essential that all completed implants should be examined by roentgenograms taken by standard technique with the film on the side closest to the implants. With the aid of a further roentgenogram taken at right angles to the first and after making alllowances for distortion it is possible to make a plan of the position of the needles and to calculate the dose delivered at various points in the implanted tissues. Stereoscopic views are frequently of value in visualizing the distribution before any plan is drawn. In some cases of complicated volume implants this two roentgenogram technique is further elaborated by carrying out a reconstruction in space of the completed implant and making direct measurements at various points by means of a suitable condenser chamber.

The planes, reconstruction and measurements are carried out by the clinical physicist, who is considered to be an essential member of any radiotherapeutic team. The roentgenograms taken of the completed implant are not only valuable for measure-

ment but may indicate that one or more needles should be withdrawn earlier than the remainder or even, if the distribution is very poor, that the whole implant should be taken out and reinserted at a later date.

The estimation of the dose which should be delivered in an individual case remains a matter of fundamental importance and calls for considerable experience and judgment. The dose necessary for successful interstitial treatment rests within the narrow limits of overdosage with consequent necrosis and underdosage with recurrence. implants of small volumes of tissue should be given higher dosage than when larger volumes are being treated. The tissues of one individual in good general condition and with good local blood supply will safely stand a dose which will not be tolerated by another who is suffering from some associated disease such as diabetes, and whose tongue is atrophic and fibrotic. In general, the doses which I have given have varied from 6,000 to 8,000 or 9,000 gamma roentgens delivered over a period of six to eight days.

Carefully controlled radium implantation will insure a high percentage of cures of the primary lesion in growths of the anterior two-thirds of the tongue, and a small percentage even in growths of the posterior third. Among tumors of the anterior two-thirds with no palpable glands, in the series which I have reported, there were 31 five year cures out of 70 patients, i.e. 44.2 per cent. Among these were included extensive growths as well as early lesions. In addition to this percentage of cured cases there were many others who died from evolution of glandular metastases with no sign of recurrence of the primary lesion.

These figures show the great value of radium needle implantation in cancer of the anterior two-thirds of the tongue. I am confident that although surgery and other forms of radiotherapy have an indispensable place, this is the method which is the most generally applicable to give the best chance of cure to patients suffering from cancer in this site.

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THE TECHNIQUE AND RESULTS OF TREATMENT OF CANCER OF THE TONGUE WITH A 10 GRAM RADIUM BEAM UNIT*

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I WOULD like to express to the American Radium Society my appreciation of their invitation to be here today.

My part in this symposium is to discuss the technique and results of treatment of cancer of the tongue by radium beam therapy.

A general view of the 10 gram radium beam unit[4] is shown in Figure 1. This apparatus was designed and the technique I shall describe was developed at the Medical Research Council's Radiotherapeutic Research Unit at Hammersmith Hospital, London. The radium source, consisting of 10 grams of radium sulphate, is transferred by pneumatic pressure along the flexible metal pipe between the storage safe and the treatment end of the unit. When the radium is in the storage safe the radiation intensity throughout the treatment room is well below the accepted tolerance value. The operator, therefore, can enter the room with safety and can spend the time necessary to direct the beam of radiation accurately without anxiety of exposure. After fixing the patient in position the operator withdraws to the observation room and blows the radium bobbin into the treatment position by remote control. So by this system adequate protection for the staff is ensured.

By the use of tungsten alloy instead of lead in the construction of the unit much better protection was obtained and the applicators were much less bulky. Three interchangeable applicators made of this alloy are used, 5 cm. diameter, 8 cm. diameter and 6 by 8 cm. rectangle. The radium skin distance is 8.3 cm. and the filtration is equivalent to 1.5 mm. platinum.

The measured isodose curves for the 5 cm. diameter circular applicator are illustrated in Figure 2. The intensity is 18 r per minute on the surface of the skin and at 5 cm. depth is 6 r per minute. The rapidly falling depth dose and the small size of the fields used in radium beam treatment make accurate directioning of the beam extremely important.

FIG. 1. General view of 10 gram radium beam unit.

To ensure this, a treatment caliper has been devised (Fig. 3). The movable pointer is so arranged that its end travels along the central axis of the beam which is repre-

* Presented in a panel discussion on End Results of Treatment of Cancer of the Tongue at the Thirtieth Annual Meeting, American Radium Society, Chicago, Ill., June 20–22, 1948.

sented by a narrow pencil of light from a lamp and lens carried on the end of the pointer. The emergent ray point, or point of exit of the beam for each field of treatment, is marked on the patient's skin. Each time the patient is set up in position for

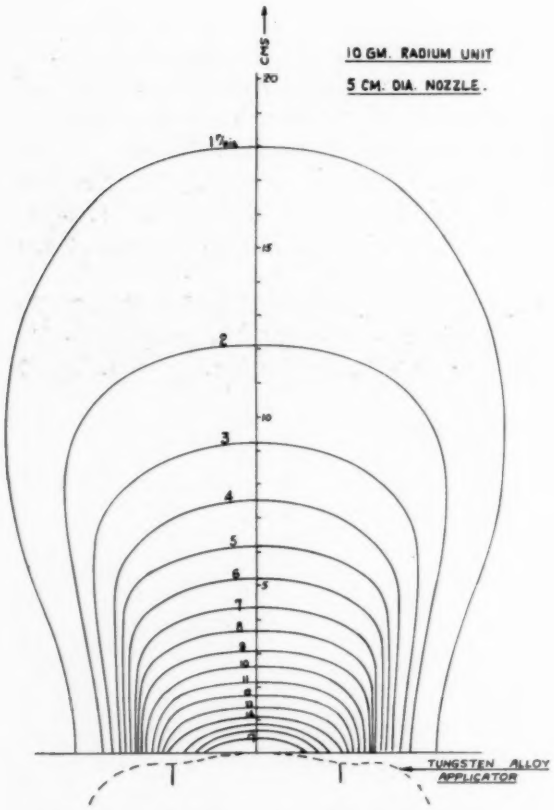


Fig. 2. Radium beam isodose curves—5 cm. diameter applicator.

treatment the angle of the radiation beam is adjusted until the light from the movable pointer has been brought into contact with the emergent ray point marked on the patient; thus each successive treatment can be repeated with precision and the error in directing the beam by eye is eliminated.

The patient is immobilized during treatment as, without this, any previous accurate aiming of the radiation beam would be rendered useless. Figure 4 shows a simple stabilizing mechanism consisting of a number of padded clamps on universal joints.

The measuring caliper[2] shown in Figure 5 was designed by T. A. Green to estimate tumor dose. The instrument is attached to the head of the radium unit and the measuring arm or pointer can move in any direction—vertically, horizontally and across the front of the beam. Three scales are provided so that the total displacement of the measuring pointer is automatically resolved into components and recorded on the three scales. To estimate the tumor dose the patient is placed in position for treatment. The pointer is then placed on the tumor and readings on the three scales are recorded. Such readings are taken for a

Fig. 3. Treatment caliper mounted on radium unit.

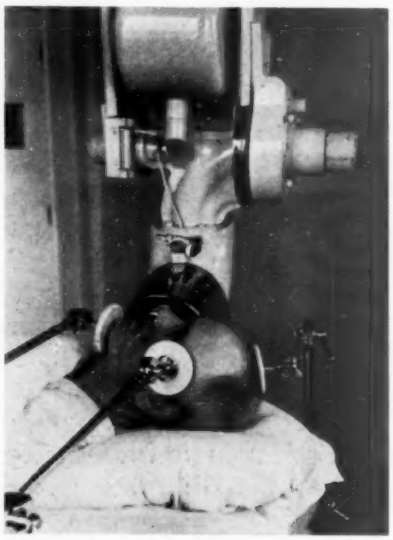


Fig. 4. Method of stabilizing patient's head.

number of points in the tumor, the glands and the skin for every field of treatment used. These measurements are carried out jointly by a radiotherapist and a physicist using a specially constructed wooden model of the unit, which allows the fields to be set up on the patient exactly as would be done during treatment, without the loss of treatment time involved if the actual unit had to be used. From the measured coordinates and the known isodose surfaces of the radium beam the dose delivered to each of the measured points in tumor, glands and skin during treatment can be calculated. These calculations are greatly facilitated by the use of a calculating table,[3] shown in Figure 6. This consists of a mechanism geometrically similar to the measuring caliper but an isodose chart engraved on a metal plate takes the place of the patient. The scale readings which brought the caliper pointer into contact with the tumor point to be measured are repeated on the corresponding scales of the calculating

Fig. 5. Measuring caliper mounted on wooden model of radium unit.

table. This brings the swivelling arm of the calculating table over the correct point on the isodose chart. The dosage rate at the measured point can thus be read off directly.

A new instrument, the dose contour finder,[1] has now been developed by P. H. Flanders for the measurement of tumor dose. This instrument represents a considerable advance in the technique of tumor dose measurement. Whereas the measuring caliper gives the dose at selected points in the tumor and glands, the contour finder affords much more complete information enabling a three dimensional picture of the

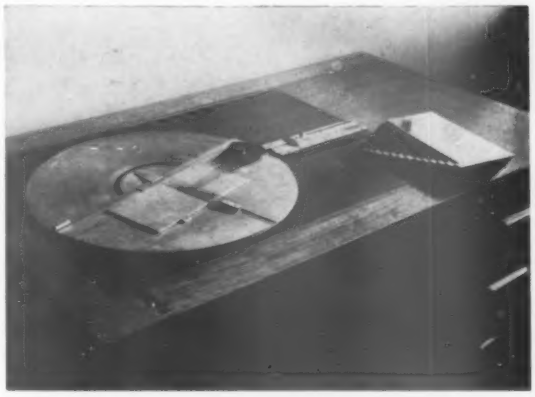


Fig. 6. Calculating table for use in estimation of dosage from caliper measurements.

dose distribution to be obtained throughout the whole of the treated area. It is possible to see at once the regions of high and low intensity and so is of the greatest assistance in arranging for the delivery of an equalized dose throughout the treated area. The amount of time and effort required to determine these contours has, in the past, prevented their general use in treatment but by the use of this instrument these drawbacks are overcome. The contour finder can be used for both symmetrical and asymmetrical fields. In Figures 7, 8 and 9 the arrangement of fields and the direction of radiation through each field found to be suitable for treating growths in the anterior two-thirds and posterior third of the tongue is shown. The isodose distribution obtained by such an arrangement of fields has been determined by the contour finder and is illustrated below.

These technical methods for beam direction and tumor dose measurement, though developed for radium beam therapy, are capable of wider application in roentgen therapy and may be used for sites other than mouth and throat. A brief description

is given below of the general plan of treatment.

Everything possible is done to improve the patient's general condition and to eliminate sepsis from the region to be treated. When this is done, radiation is very much better tolerated.

growth in the tongue is irradiated through the glands in the neck. This has resulted in an economy of the total amount of radiation received by the body and so diminishes the possibility of undesirable constitutional effects.

Great importance has been attached to

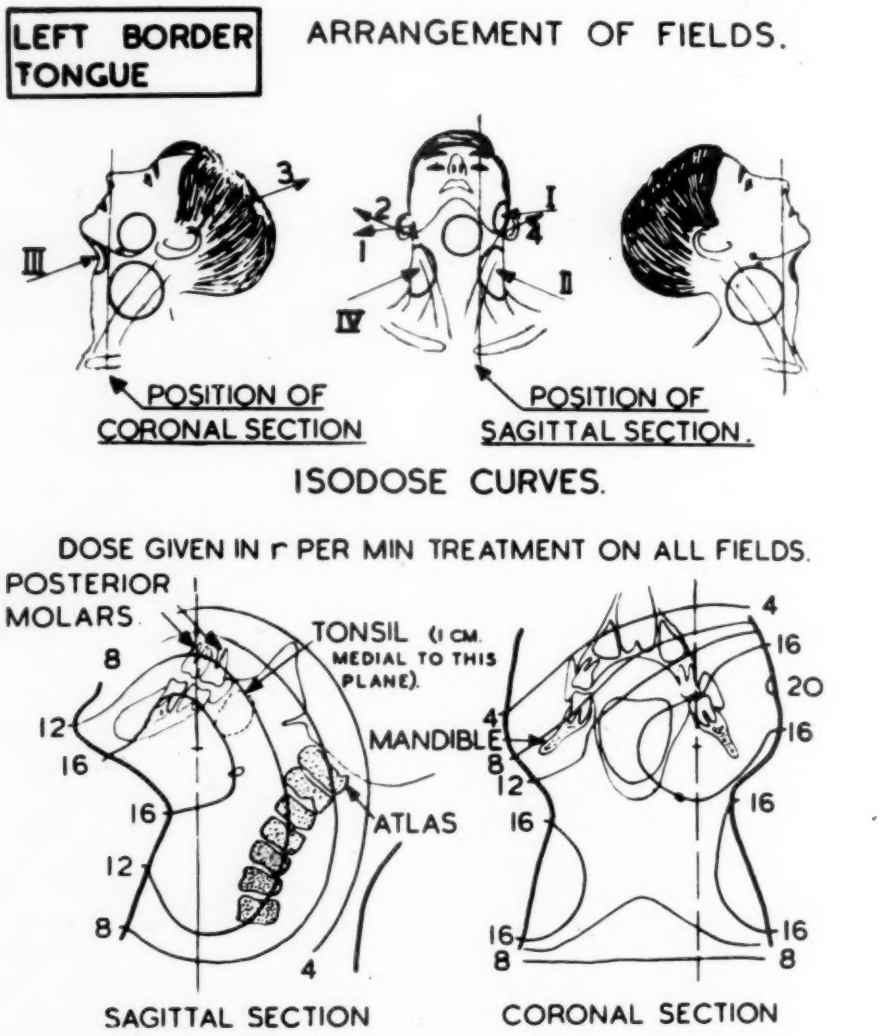


FIG. 7. Arrangement of fields for treatment of lateral border of tongue.

The treatment is planned to deliver an adequate and uniform dose of radiation throughout the whole of the cancer bearing area; that is, to the lymphatic glands in the neck as well as to the primary growth. The fields of treatment and the direction of the beam through each field have been so planned that as far as possible the primary

the radiation of the glandular areas. In the results reported, in no case has a block dissection of the glands been performed. By giving as homogeneous a dose as possible throughout the whole of the cancer bearing area data have been obtained from which a comparison can be made of the response of primary tumor and glands

when both receive comparable dosage.

When planning the fields of treatment the first step is to define as accurately as possible the limits of the primary growth and its lymphatic spread. The radiotherapist, after examining the patient, marks up already described, and any modifications deemed necessary in the light of the isodose distributions obtained are then made.

For each patient treated a dosage graph (Fig. 10) is plotted showing the rising total in roentgens to tumor, glands and skin on

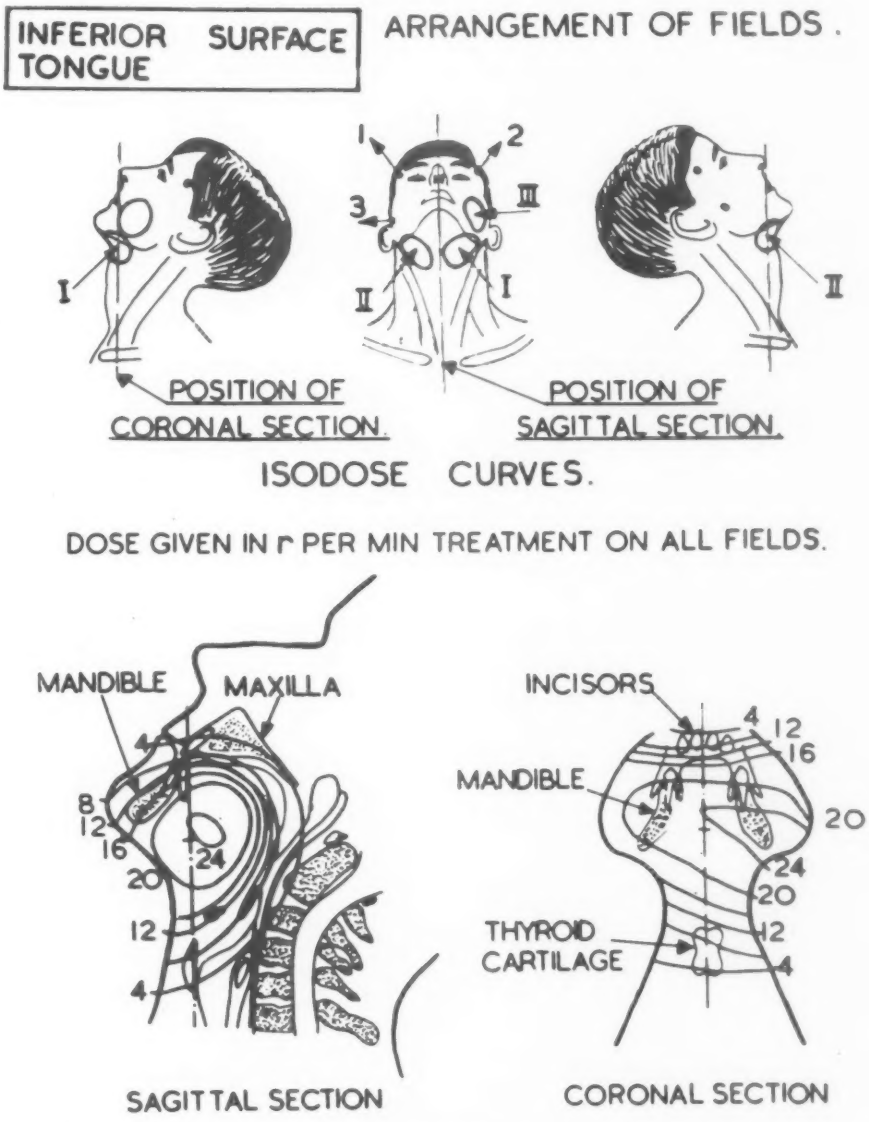


Fig. 8. Arrangement of fields for treatment of inferior surface of tongue.

the particular arrangement of fields which seems best, arranging wherever possible to irradiate the primary growth through the glandular areas. This arrangement of fields is then investigated physically using either the measuring caliper or the contour finder

successive days of treatment. This graph is of great assistance in the prescription of treatment.

It was the aim during treatment to deliver a dose of approximately 6,000 r to the tumor and glands over a period of forty-two

days. The tumor dose is therefore given at the rate of 1,000 r per week. Patients usually receive one, or at most, two treatments per day. The treatment time is twenty-two and a half minutes, the dose delivered to the skin in that time being 410 r. The aim of the 6,000 r tumor dose in forty-two days is necessarily varied according to the condition of the patient and the reactions obtained.

In the majority of cases the total dose to both primary lesion and glands was delivered by external irradiation. In some few cases, however, and this refers particularly to anterior two-thirds of tongue, when there was some induration left at the site of the primary after external irradiation, additional local treatment was given to the primary lesion only, either in the form of diathermy excision or radium needling. The timing of the accessory treatment is important. It is given as soon as possible after the external irradiation is completed, with the object of preventing reinfection of

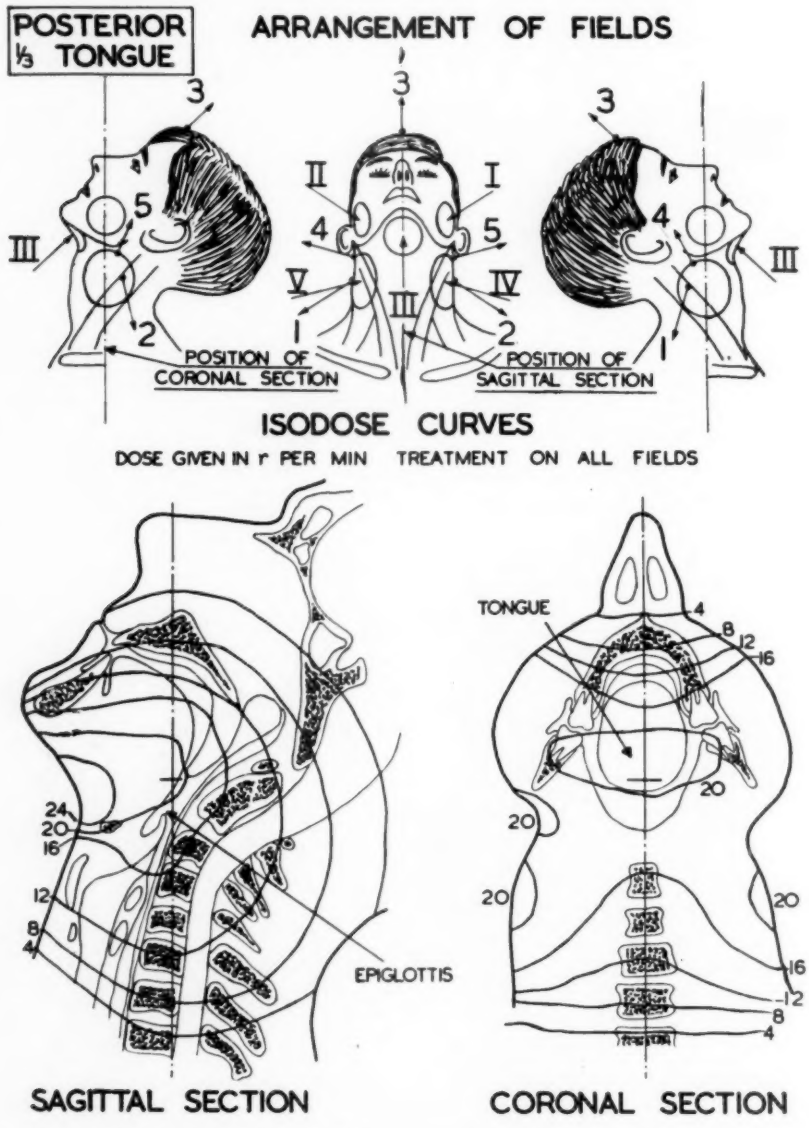


Fig. 9. Arrangement of fields for treatment of posterior surface of tongue.

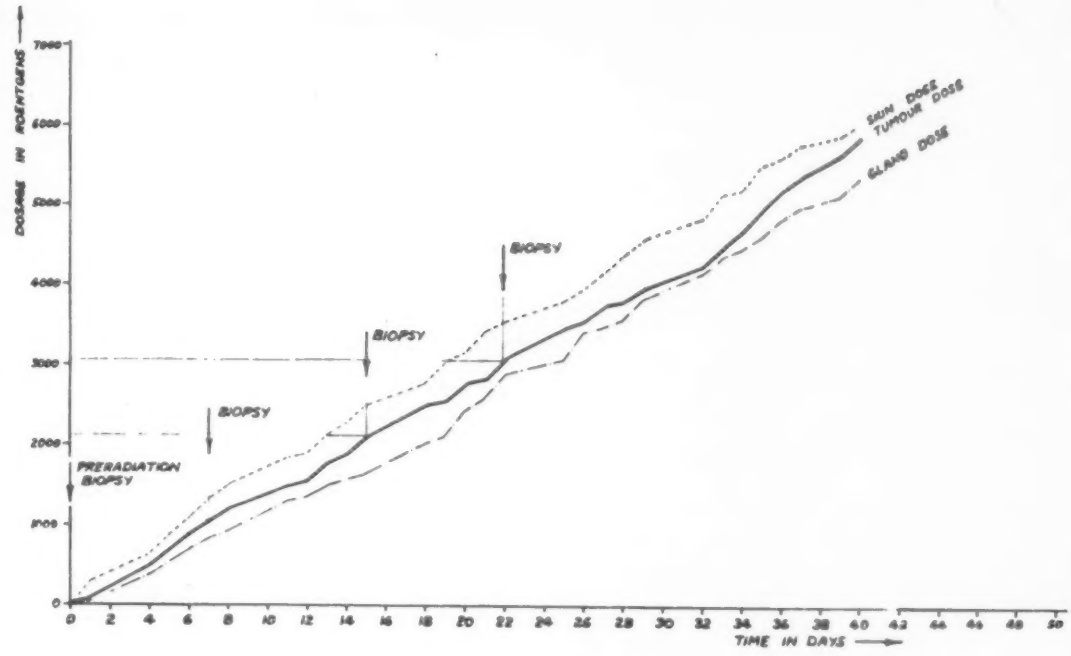
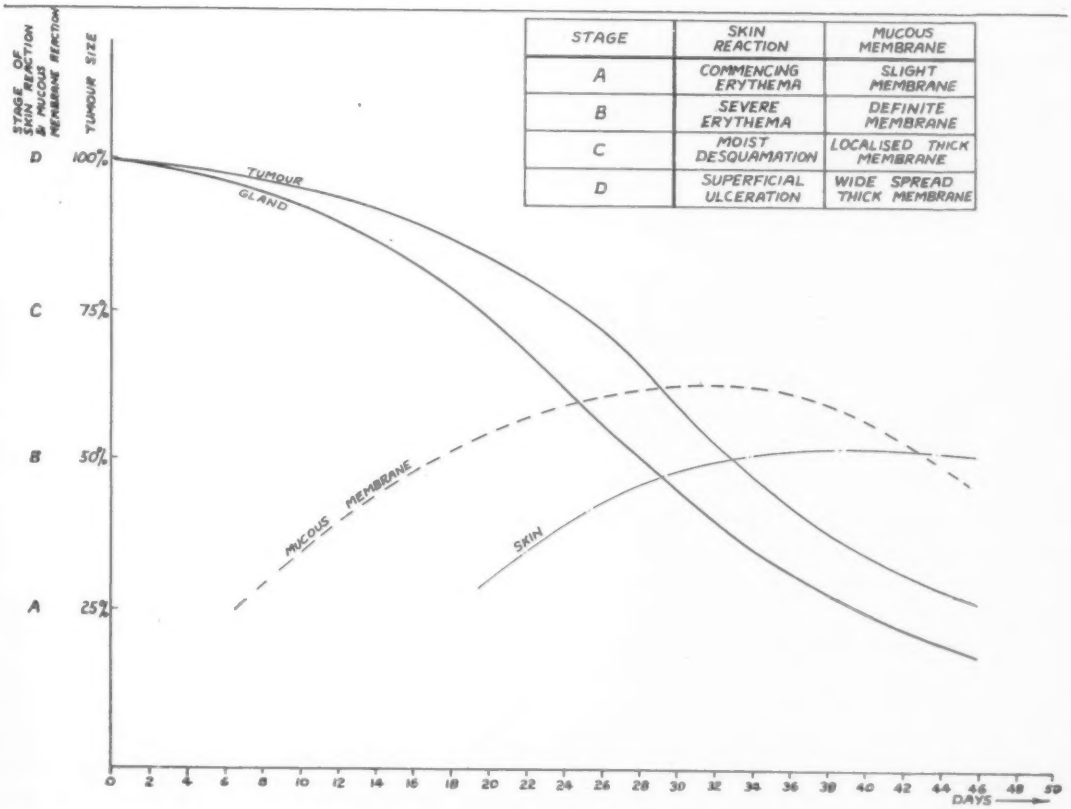


FIG. 10. Dosage graph.



STAGE	SKIN REACTION	MUCOUS MEMBRANE
A	COMMENCING ERYTHEMA	SLIGHT MEMBRANE
B	SEVERE ERYTHEMA	DEFINITE MEMBRANE
C	MOIST DESQUAMATION	LOCALISED THICK MEMBRANE
D	SUPERFICIAL ULCERATION	WIDE SPREAD THICK MEMBRANE

FIG. 11. Reaction graph.

lymph nodes from a source of unsterilized cancer cells at the primary site.

In addition to the dosage graph which is kept for each patient, another graphical record, the reaction graph, is also made (Fig. 11). This depicts the immediate response of tumor and glands to a known dose of radiation and also the severity and time of onset of the reaction of the skin and mucous membrane to that dose. It is from these data that the response of the primary tumor and glands has been compared.

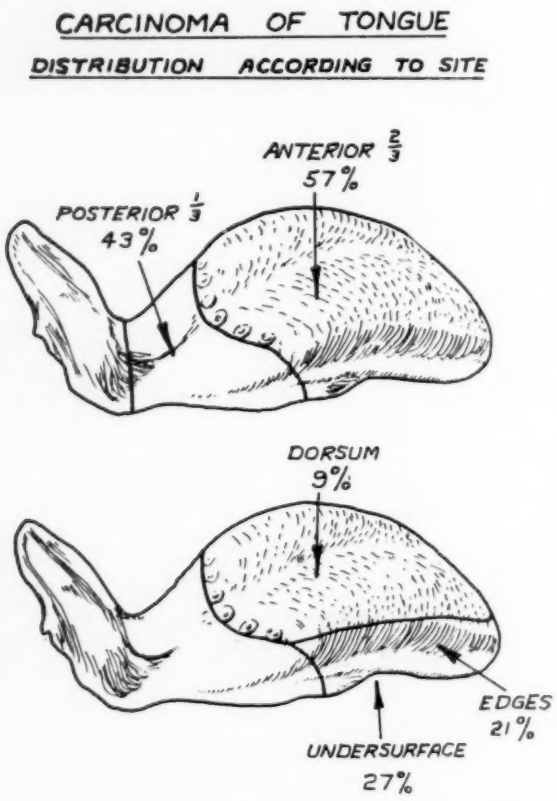


Fig. 12. Diagram of tongue showing proportion of tumors in different sites.

From studies[5] made on tumor and glandular regression time and dose, it was found that there were about as many cases in which the glands responded more rapidly than the tumor as there were cases in which the tumor responded more rapidly than the glands. It is concluded that when comparable doses are given to each, the glands offer no greater resistance to radiation treatment than does the primary growth. This belief is supported by an analysis which has been made of some 400 patients with cancer of the mouth and throat treated by radium beam who died with cancer present. In nearly all instances, patients who have died have been seen a few weeks before death and a clinical examination made to determine presence or absence of growth at the primary site, in glands or in distant metastases. Post-mortem examinations have been made whenever possible. The majority of patients who had no glands at the beginning of treatment died without cancer in glands, while the majority of those with glands present at the beginning of treatment had cancer in both primary and glands at the time of death. These figures do not support the view that glands offer greater resistance to irradiation than does the primary growth. It would appear, therefore, that we must search for some other explanation to account for the higher mortality rate universally found in patients with lymph node involvement.

As I have already mentioned, this treatment has been carried out in a Research Unit. The total number of patients treated is not large. It must be emphasized, however, that this number represents, with very few exceptions, the total number of cases referred to the Research Unit for treatment. Out of a total of 192 cases of cancer of the tongue referred to the Research Unit, 182 cases were treated, the remaining 10 cases having either refused or abandoned treatment. Patients are referred to the Unit from the various surgical and ear, nose and throat clinics of the London hospitals. Apart from any selection which may occur in the surgical clinics before the patients are referred to us, the figures presented here represent an unselected group of cases of all degrees of advancement. Palliation was the most that could be hoped for in many cases; no patient was refused treatment on account of the advanced stage of the disease.

The percentages of tumors arising in

different portions of the tongue is illustrated in the diagram shown in Figure 12. It will be seen that 43 per cent occurred on the posterior third and 57 per cent on the anterior two-thirds; of the latter, 9 per cent occurred on the dorsum, 21 per cent on the sides and 27 per cent on the inferior surface. The age and the sex incidence in the whole group is shown in Figure 13. The

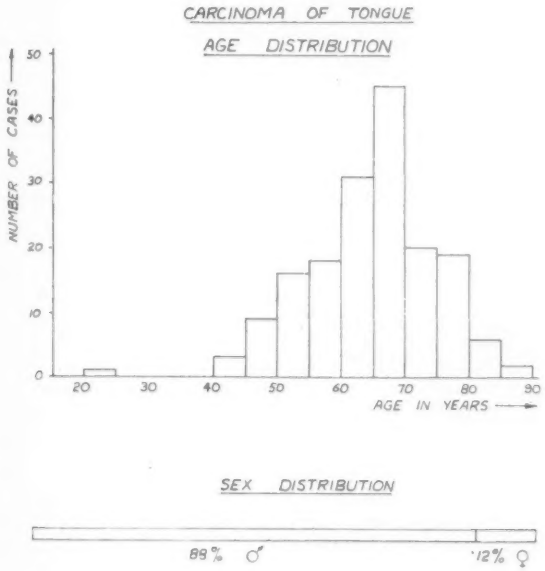


FIG. 13. Diagram showing sex and age incidence.

greatest number of cases occurs in the age group 65–70 years; only 12 per cent of the cases occurred in women.

The length of history in patients suffering from cancer of the tongue is short; the average time, as may be seen from the chart shown in Figure 14, is of the order of two to three months.

Some idea of the degree of advancement of this group of cases as a whole may be gained from an analysis which has been made according to the size of the primary tumor. On the left hand side of Figure 15, the size of the primary growth is shown in the form of a chart, the area of the growth being given in square centimeters, and on the right hand side the diameter of the growth is given. It will be seen that the large majority of the cases have reached a considerable size, 51 per cent being greater than 4 cm. in diameter.

The incidence of lymph node involvement is illustrated in Figure 16; 56.7 per cent of cases occurring on the anterior two-thirds of the tongue had lymph node in-

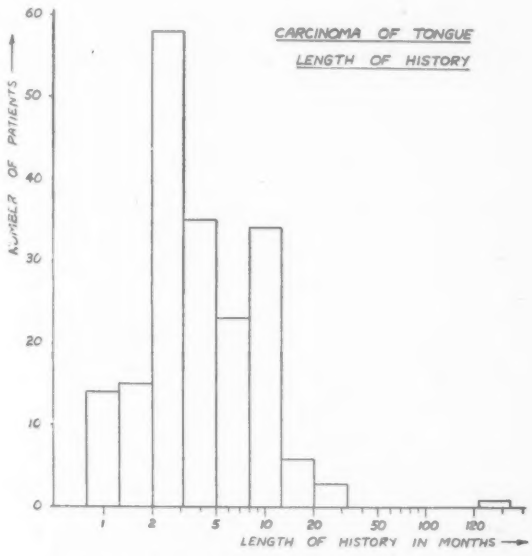


FIG. 14. Chart showing length of history.

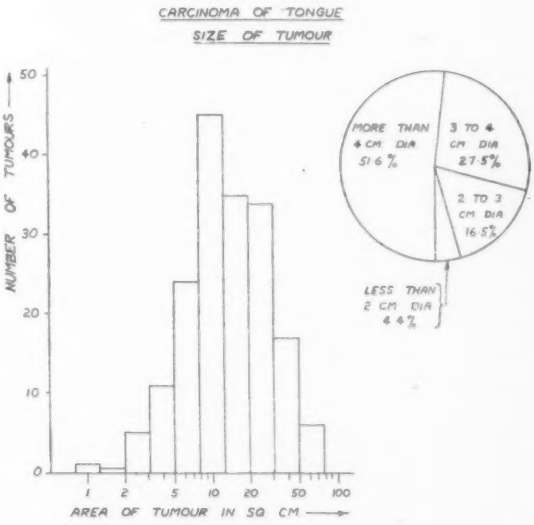


FIG. 15. Diagram showing size of tumors.

volvement at the beginning of treatment, and 73 per cent of cases on the posterior one-third. When the two sites are grouped together, it will be seen that 63.8 per cent of the total cases had lymph node involve-

ment at the beginning of treatment. In none of these cases was a block dissection of the glands performed, so that the diagnosis of lymph node involvement was made on clinical examination, and has not been proved microscopically except in those

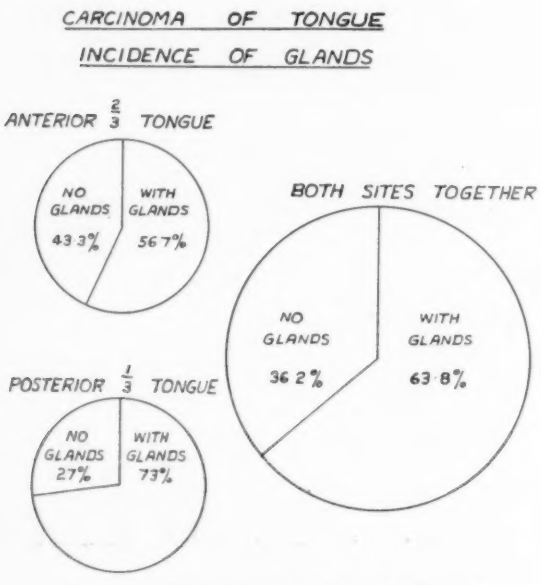


Fig. 16. Diagram showing incidence of glandular involvement.

cases coming to postmortem examination. I think that an experienced clinician is rarely mistaken in the diagnosis of malignant glands. Only those glands in this series of cases have been regarded as malignant which are hard on palpation and persist after sepsis has been cleared up. There are, I think, very few cases in which hard nodes are palpable where the histopathology is not positive.

In order to test this, a series of 76 cases at Hammersmith Hospital were investigated. In all these cases there was a record of the clinical diagnosis as to the presence of malignant glands either before a block dissection of the neck was performed or a postmortem examination was made. In this series the following agreement between clinical and histopathological findings was obtained (Table I):

Table I

	Glands Palpable	Not Palpable	
Histopathologically malignant	53	5	58
Histopathologically not malignant	6	12	18
	59	17	76

It can be seen that the clinician estimated that malignant glands were present in 59 cases out of 76 and the histopathology was positive in 58 cases.

Table II

Percentage survival rate (182 cases of cancer of the tongue)—actuarial method

Site: Tongue—all cases				Total No. of patients seen 192 Total No. of patients treated 182			
Time from Treatment	Number Entering	Withdrawals		At Risk	Cancer Deaths	Fraction Surviving	Survival Rate Per Cent
		Intercurrent deaths	Alive*				
0–1 yr.	182	5	0	179·5	80	·555	56
1–2 yr.	87	6	1	83·5	25	·701	39
2–3 yr.	55	1	1	54	12	·778	30
3–4 yr.	41	5	1	38	3	·921	28
4–5 yr.	32	2	7	27·5	2	·927	26

* Patients in this column are still alive and symptom free but have been under observation for only a limited period. Thus patients in this group in the period 2–3 years are still alive and symptom free after a period of between two and three years, but must be withdrawn from all subsequent periods.

There were naturally a few cases of disagreement but a statistical examination of this table makes it quite clear that the obtained agreement—85 per cent ($(53+12/76)\times 100=85$ per cent)—could not have been obtained by chance (1 chance in 3 million).

In Table II the percentage survival rate is given for 182 cases of carcinoma of the tongue. These percentages have been calculated according to the actuarial method —the intercurrent deaths have been carefully checked. No case is included under this head unless the cause of death was known and there was no evidence of cancer present at the time of death. When this check is satisfactory the actuarial method of calculating the five year survivals seems more rational than a method in which all intercurrent deaths occurring within the five year period are reckoned as indeterminate and therefore unable to add their due weight to the proportion of patients cured.

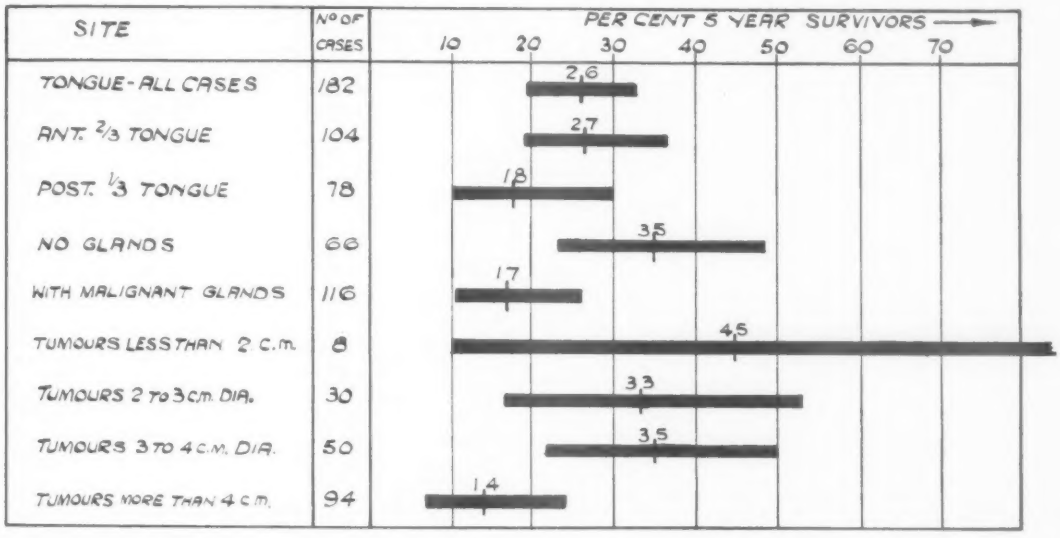


FIG. 17. Percentage five year survivors (182 cases of cancer of the tongue) with confidence limits.

In Figure 17 the five year survival rates for this same series of cases are shown with the confidence limits for each group represented by the black lines. When a limited number of patients has been treated, the five year survival rate for such a group does not enable us to say with certainty what the survival rate would be if a much larger group of patients were treated—that is to say, what is the true survival rate for the method of treatment. Knowing the number of patients treated and their five year survival rate, however, from elementary statistical theory one can quote limits between which the true value will lie in most cases. We wish to keep the limits as close as possible in order to detect small differences between methods of treatment and we must therefore adopt by convention some "measure of confidence." If we accept limits within which the true value should lie, in 19 cases out of 20 we shall be following ordinary statistical practice. Such confidence limits are indicated by the length of the black lines in the diagram. These confidence limits are seen to vary in length according to the number of patients in each group—the larger the number of cases, the nearer do the confidence limits approach the estimate.

The influence of the stage of advancement of the growth on the five year survival rate is shown by these figures. The survival rate in cases without lymph node involvement at the beginning of treatment is 35 per cent as compared with 17 per cent in cases where the nodes were involved.

Again, when the total series is analyzed according to the size of the primary growth this same influence of degree of advancement is shown. The number of cases in this series with a primary lesion less than 2 cm. in diameter is too small a group from which to draw any definite conclusions—half of these cases are alive after five years. In the larger group of cases where the size of the primary was between 3 and 4 cm. in diameter, the five year survival rate is 35 per cent, while in the much more advanced group where the primary lesion was over 4 cm. in diameter the survival rate is 14 per cent. These differences are significant.

We must not lose sight of the value of palliation. We found in our series that not only do the treated patients live longer but their life is rendered more comfortable and free from pain. There is frequently a period in which they are either symptom free or their symptoms are alleviated. When a recurrence does arise, it is less unpleasant and painful for the patient than in untreated cases. Boag[5] compared the survival rate in our series of cases dying from cancer with Greenwood's figures for a group of untreated cases in the same site. He found that the treated cases have a significantly longer life. There seems no doubt, therefore, of the value of palliative treatment in those cases where the disease is too far advanced to justify any expectation of a permanent cure.

The proportion of cases of cancer of the tongue successfully treated by irradiation is sufficient to encourage a concerted effort being made to improve radically on the present level of achievement.

An attempt has been made in this paper to give some account of the very considerable improvements which have been made in the technique of directing radiation beams and in measuring the dose distribution in and around tumors. It must be pointed out, however, that these great improvements in technique have not resulted in a commensurate improvement in the percentage of patients cured.

It is in general no longer possible to ascribe failures in radiotherapy to an inability to deliver the predetermined dose of radiation to the tumor. These improvements in technical methods made possible by the researches of the last ten years were an essential preliminary step. It must be concluded, however, that there are other factors than physical dosage which have a fundamental effect on the response of tumors to irradiation. The problem has become one of radiobiology. A study which has been made to discover one of the biological factors which determine a satisfactory response to irradiation is the subject of another paper.

The author is very much indebted to Mr. J. W. Boag for making all the statistical analyses in this paper. She wishes to express her thanks to Mr. R. J. Post for drawing the diagrams and to Mr. E. V. Willmott, F.R.P.S., at the Postgraduate Medical School of London, for the photography.

Radiotherapeutic Research Unit
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Vol. 63, No. 5

DEPARTMENT OF TECHNIQUE

Department Editor: Robert B. Taft, M.D., B.S., M.A., 103 Rutledge Ave. Charleston, S. C.

AN ADDITIONAL TECHNIQUE FOR THE ROENTGEN DEMONSTRATION OF THE FIRST CERVICAL VERTEBRA

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UNIVERSITY, MISSISSIPPI

AN ADEQUATE, complete roentgen demonstration of the first cervical vertebra with the views commonly used is often difficult. The anteroposterior projection through the open mouth accomplishes a frontal projection of the first cervical with its relation to the odontoid process of the second cervical vertebra and the occipital articular facets. Disturbances in these relationships are frequently observed as evidence of fracture or dislocation of the first cervical vertebra or some of its supporting structures. However, the anterior and posterior arches cause superimposed shadows in this projection. In a similar manner, the lateral projection of the cervical spine, while offering conclusive evidence in many cases of dislocation and/or fracture, again shows superimposed shadows of the two lateral masses and of the arches.

The occipitosubmental projection recommended by Jackson[1] succeeds in offering an almost true superoinferior projection of the first cervical vertebra, but here again there is superimposition of the upper cervical vertebrae which obscures much of the fine detail of the bony structure of the first cervical vertebra. The multiplicity and variety of fractures in this area observed in war wounds make it desirable at times to secure a relatively unobstructed view of the first cervical vertebra in cases where the above described techniques have failed to give the desired information and where there is definite clinicial evidence of a pathological condition.

This article has for its purpose the presentation of an additional technique for the demonstration of the first cervical vertebra. It has been found possible to project the first cervical vertebra through the base of the skull in such a way that the lateral mass and the corresponding half of the posterior arch are clearly demonstrated. Most of the visualization of this structure is through the foramen magnum without any bony superimposition and obscuration of bony detail. One lateral mass and the corresponding half of the posterior arch can be demonstrated in one exposure and may be duplicated on the opposite side, thus providing adequate visualization of the lateral masses, the transverse processes, the entire posterior arch, and the posterior tubercle which constitutes all of the first cervical vertebra except the relatively small anterior arch. It has been found possible to duplicate the results satisfactorily in a series of cases where the flexibility of the cervical spine is not seriously impaired. The method suggested in this article is, of course, not applicable for examination of fresh injuries where the presence or absence of a fracture or dislocation is as yet unknown. Neither is it applicable to cases in

[1] Jackson. In: Head and Neck in Roentgen Diagnosis. By Pancoast, H. K., Pendergrass, E. P., and Schaeffer, J. P. Charles C Thomas, Springfield, Illinois, 1940, p. 148.

which there is marked limitation of the cervical spine. It has been found to be of practical value in a series of post-traumatic cases which have attained a fixed degree of chronicity in which the existing pathological condition has not previously been clearly demonstrated.

The technique for this projection is as follows:

The patient is placed prone on a Potter-

FIG. 1. Patient in position demonstrating sagittal plane of skull making a 12 degree angle with the table top. The central ray enters at an angle of 23 degrees.

Bucky table. The head is rotated toward the side to be roentgenographed until a true lateral position is obtained. Using a 12 degree angle card as a guide, the upper portion of the patient's head is elevated with sand bags until the sagittal plane through the head forms a 12 degree angle with the table top. It is essential that only the head participate in this 12 degree angle and that as much of the cervical region as possible remain in contact with the table top. The roentgen tube is now moved into position for a 23 degree angle tilt toward the feet with the central ray entering the skull 5 cm. above and 5 cm. behind the external auditory meatus, and the film is centered to the central ray so projected.

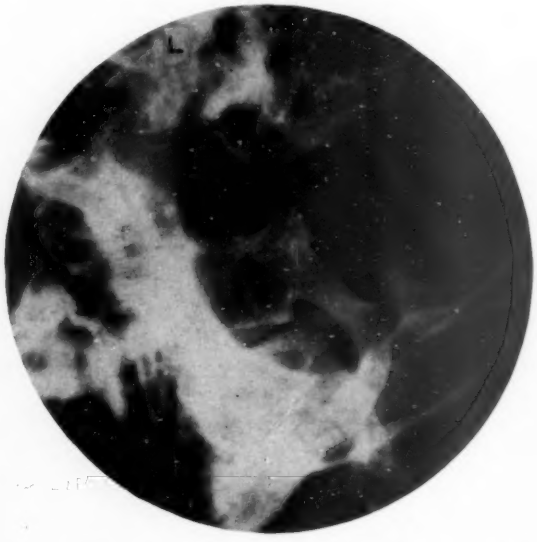

FIG. 2. View demonstrating left lateral mass and the corresponding half of the posterior arch.

SUMMARY

1. An additional technique has been described which gives an unobstructed view of the two lateral masses and the entire posterior arch of the first cervical vertebra essentially in a superoinferior projection.

2. The method described is capable of satisfactory duplication of results.

The author extends her grateful appreciation to Dr. J. Emmerson Noll, Radiologist, Port Jervis, New York, for his kind assistance.

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Fifty-first Annual Meeting: Jefferson Hotel, St. Louis, Mo., September 26–29, 1950.

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President: William S. MacComb, New York, N. Y.; *President-Elect:* Leland R. Cowan, Salt Lake City, Utah; *1st Vice-President:* James A. Corscaden, New York, N. Y.; *2nd Vice-President:* Douglas J. Roberts, Hartford, Conn.; *Secretary:* Hugh F. Hare, 605 Commonwealth Ave., Boston, Mass.; *Treasurer:* Howard B. Hunt, University Hospital, Omaha, Nebr.

Executive Committee: Charles L. Martin, Chairman, Dallas, Texas, A. N. Arneson, St. Louis, Mo., Maurice Lenz, New York, N. Y.

Program Committee: Leland R. Cowan, Chairman, Salt Lake City, Utah, Joseph Farrow, New York, N. Y., John L. Pool, New York, N. Y.

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Janeway Lecture Committee: Douglas Quick, Chairman, New York, N. Y., G. Failla, New York, N. Y., F. W. O'Brien, Boston, Mass.

Representatives on American Board of Radiology: Douglas Quick, Chairman, New York, N. Y., B. P. Widmann, Philadelphia, Pa., F. W. O'Brien, Boston, Mass.

Committee on Arrangements: Gordon P. McNeer, Chairman, New York, N. Y., Gray H. Twombly, New York, N. Y., Theodore R. Miller, New York, N. Y.

Advisory Committee on X-ray and Radium Protection of the National Committee on Radiation Protection: Edith H. Quimby, New York, N. Y., John E. Wirth, Baltimore, Md.

Exhibit Committee: Robert E. Fricke, Chairman, Rochester, Minn., William Harris, New York, N. Y., Milton Friedman, New York, N. Y.

Thirty-second Annual Meeting: Roosevelt Hotel, New York, N. Y., May 25–26, 1950.

EDITORIALS

ANTAGONISM OF ORGANS

A REMARKABLE feature of normal growth is the precise accommodation of adjacent organs to each other. In confined spaces there is no overcrowding. The size of the skull corresponds to the volume of the brain, the foramina in bones and fascia are no larger or smaller than the nerves or vessels that pass through them, and cavities in general are well suited to the volume of their contents.

When anatomical variations are present there has been a tendency to explain symptoms on a failure of accommodation of adjacent organs. A cervical rib may be said to be "pressing" on the brachial plexus, an aberrant renal artery "narrows" the lumen of a ureter, a large thymus "presses" on the trachea, in platybasia and the Arnold-Chiari malformation the medulla oblongata and the cerebellum have been said to "plug" the foramen magnum and cervical canal causing obstruction to the flow of cerebrospinal fluid, or variations in the development of the aortic arches may be said to form "constricting" rings about the trachea and esophagus. These are examples where organs of normal structure have been considered as exerting a harmful effect on neighboring organs. In most instances where these situations exist there does appear to be a satisfactory accommodation of adjacent organs but at times there are signs and symptoms which indicate that one structure is interfering with another in an antagonistic manner. To be considered is whether the fault lies entirely with the antagonist or whether there is also a fault with the agonist which permits itself to be adversely affected by the antagonist. The limitations of language and the metaphorical use of words may obscure a proper understanding of the situation. In the examples which have been given there was at first a general acceptance of the notion of antagonism. This has been followed by skepticism, and sometimes by complete disbelief. Perhaps the notion of an antagonism does not have equal merit in the examples cited.

The concept of the constricting vascular ring is now being evaluated through the growing ability of the radiologist to recognize vascular anomalies of the aortic arch and the ability of the surgeon to develop corrective procedures. It is already clear that the vascular anomalies are much more common than has been generally appreciated and that they are often not productive of symptoms. Having found such an anomaly one must give consideration to the following questions. Is the anomaly causing a deformity or disturbance in function of neighboring structures? Are there symptoms of such severity and of sufficient hazard to life to warrant the risk of operation? Will a plastic operation on one structure correct the deformity of the neighboring structure which is productive of symptoms? At what age is it most desirable to perform the operation? To be more specific, if an overlying vessel is associated with a deformity of the trachea will removal of the vessel correct the deformity of the trachea or is there an inherent structural defect in the trachea that predisposes to deformity?

Answers to these questions must await a critical evaluation of a greater number of cases than have been studied thus far.

William A. Evans, Jr., M.D.

EDMUND VAN BUSKIRK
1875-1950

DR. EDMUND VAN BUSKIRK of Fort Wayne, Indiana, son of Linford and Mary (Knouse) Van Buskirk, died on January 18, 1950, at the age of seventy-four.

Van, as he was known throughout Indiana, was very active in local and state medical organizations. He was a past president of the Indiana State Medical Association, secretary of the Allen County Health Organization for sixteen years and a member of the State Health Organization for several years. He was also a member of the American Roentgen Ray Society, the Radiological Society of North America, Fellow of the American College of Radiology, and a diplomate of the American Board of Radiology. He was very faithful in attendance at local, as well as national, medical meetings.

Dr. Van Buskirk was a graduate of the public schools of Allen County and of the Old Fort Wayne Medical College in 1902. Upon graduation from medical school, he entered general practice in Fort Wayne, Indiana.

During World War I, he served in the Medical Corps as a Captain at Camp Beauregard, Louisiana. After the war, he did post-graduate work in roentgenology and returned to Fort Wayne to devote his entire time to this specialty. At the time of his death, he was radiologist to the Methodist Hospital, Fort Wayne, Indiana, and the Fort Wayne X-ray Laboratory.

During his life, he was always interested in the welfare of the younger physicians of the community, always giving them encouragement and sound advice on medical as well as non-medical matters. For years, he was active in the work and religious life of

Edmund Van Buskirk

the Trinity English Lutheran Church of Fort Wayne.

Dr. Van Buskirk is survived by his wife, Louise; one daughter, Mrs. Alice Alter, Fort Wayne; and a son, Dr. Edmund Van Buskirk, Jr., of Lafayette.

C. H. WARFIELD, M.D.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. Barton R. Young, Germantown Hospital, Philadelphia 44, Pa. Annual meeting: Jefferson Hotel, St. Louis, Mo., Sept. 26–29, 1950.

American Radium Society
Secretary, Dr. H. F. Hare, 605 Commonwealth Ave., Boston, Mass. Annual meeting: Roosevelt Hotel, New York, N. Y., May 25–26, 1950.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N.Y. Annual meeting: 1950, to be announced.

American College of Radiology
Executive Secretary, William C. Stronach, 20 N. Wacker Drive, Chicago 6. Annual meeting: 1950, to be announced.

Section on Radiology, American Medical Association
Secretary, Dr. Paul C. Hodges, 950 E. 59th St., Chicago, Ill. Annual Meeting: San Francisco, Calif., June 26–30, 1950.

Alabama Radiological Society
Secretary, Dr. W. W. Anderson, Tuscaloosa, Ala. Meets time and place Alabama State Medical Association.

Arizona Association of Pathologists and Radiologists
Secretary, Dr. R. Lee Foster, 507 Professional Bldg., Phoenix, Ariz. Two regular meetings a year. The annual meeting at time and place of State Medical Association and interim meeting six months later.

Arkansas Radiological Society
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

Atlanta Radiological Society
Secretary, D. W. W. Bryan, 490 Peachtree St., N.E., Atlanta, Ga. Meets monthly, except during three summer months, on second Friday evening.

Brooklyn Roentgen Ray Society
Secretary, Dr. J. J. Daversa, 345 75th St., Brooklyn, N. Y. Meets monthly fourth Tuesday, Oct. through April.

Buffalo Radiological Society
Secretary, Dr. Mario C. Gian, 610 Niagara St., Buffalo, N. Y. Meets second Monday evening each month, October to May inclusive.

Central New York Roentgen Ray Society
Secretary, Dr. Dwight V. Needham, 608 E. Genesee St., Syracuse N. Y. Meets January, May, November.

Central Ohio Radiological Society
Secretary, Dr. Paul D. Meyer, Grant Hospital, Columbus, Ohio. Meets at 6:30 P.M. on second Thursday of October, December, February, April, and June at Seneca Hotel, Columbus, Ohio.

Chicago Roentgen Society
Secretary, Dr. John H. Gilmore, 720 N. Michigan Ave., Chicago 11, Ill. Meets second Thursday of each month October to April inclusive at the University Club.

Cincinnati Radiological Society
Secretary, Dr. E. C. Elsey, 927 Carew Tower, Cincinnati 2, Ohio. Meets last Monday of each month, September to May, inclusive.

Cleveland Radiological Society
Secretary, Dr. J. R. Hannan, Cleveland Clinic, Cleveland 6, Ohio. Meetings at 6:30 P.M. on fourth Monday of each month from October to April.

Colorado Radiological Society
Secretary, Dr. Paul E. RePass, 306 Republic Bldg., Denver 2, Colo. Meets third Friday of each month at University of Colorado Medical Center or at Denver Athletic Club.

Connecticut Valley Radiologic Society
Secretary, Dr. E. W. Godfrey, 1676 Boulevard, West Hartford, Conn. Meets second Friday Oct. and April.

Dallas-Fort Worth Roentgen Study Club
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meets in Dallas on odd months and in Fort Worth on even months, on third Monday, 7:30 P.M.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. W. G. Belanger, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

East Bay Roentgen Society
Secretary, Dr. Dan Tucker, 434-30th St., Oakland 9, Calif. Meets first Thursday each month at Peralta Hospital, Oakland.

Florida Radiological Society
Secretary, Dr. F. K. Hurt, Riverside Hospital, Jacksonville, Fla. Meets twice annually, in the spring with the annual State Society meeting, and in the fall.

Georgia Radiological Society
Secretary, Dr. Robert Drane, DeRenne Apartments, Savannah, Ga. Meets in mid-winter and at annual meeting of Medical Association of Georgia in the spring.

Greater Miami Radiological Society
Secretary, Dr. David Kirsh, 712 duPont Bldg., Miami 32, Florida. Meets last Wednesday of each month at 8:00 P.M. at Veterans Administration Regional Office.

Houston X-ray Club
Secretary, Dr. Curtis H. Burge, 3020 San Jacinto St. Houston 4, Texas. Meets fourth Monday each month.

Radiological Society of Kansas City
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

Illinois Radiological Society
Secretary, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

Indiana Roentgen Society
Secretary, Dr. William M. Loehr, 712 Hume-Mansur Bldg., Indianapolis 4. Meets second Sunday in May.

Iowa X-Ray Club
Secretary, Dr. Arthur W. Erskine, 326 Higley Bldg., Cedar Rapids, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. Special meetings by announcement.

Kansas Radiological Society
Secretary, Dr. Anthony F. Rossitto, Wichita Hospital, Wichita, Kan. Meets annually with State Medical Society.

Kentucky Radiological Society
Secretary, Dr. W. C. Martin, 321 W. Broadway, Louisville. Meets annually in Louisville on first Saturday in Apr.

Kings County Radiological Society
Secretary, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:45 P.M.

Los Angeles Radiological Society
Secretary, Dr. Wybren Hiemstra, 1414 S. Hope St., Los Angeles 15, Calif. Meets second Wednesday each month at Los Angeles County Medical Assn. Building.

Louisiana Radiological Society
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

* Secretaries of societies are requested to send timely information promptly to the Editor.

Louisville Radiological Society
Secretary, Dr. E. L. Pirkey, Louisville General Hospital, Louisville 2, Ky. Meets monthly on second Friday at Seelbach Hotel, Louisville.

Miami Valley Radiological Society
Secretary, Dr. G. A. Nicoll, 134 Apple St., Dayton, Ohio. Meets second Friday of fall and winter months.

Michigan Association of Roentgenologists
Secretary, Dr. R. D. McDuff, 220 Genesee Bank Bldg., Flint 3, Mich.

Milwaukee Roentgen Ray Society
Secretary, Dr. T. J. Pfeffer, 839 N. Marshall St., Milwaukee 2, Wis. Meets monthly on second Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. L. A. Nash, 572 Lowry Medical Arts Bldg., St. Paul 2, Minn. Meets three times annually, once at time of State Med. Assn., and in spring and fall.

Nebraska Radiological Society
Secretary, Dr. J. E. Downing, 816 Medical Arts Bldg., Omaha, Nebr. Meets fourth Thursday of each month at 6 P.M. at Omaha or Lincoln.

New England Roentgen Ray Society
Secretary, Dr. George Levene, Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday, Harvard Club.

New Hampshire Roentgen Ray Society
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

New York Roentgen Society
Secretary, Dr. F. H. Ghiselin, 111 East 76th St., New York 21, N. Y. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Radiological Society
Secretary, Dr. J. E. Hemphill, 1420 E. Fifth St., Charlotte 4, N. C. Meets in May and October.

North Dakota Radiological Society
Secretary, Dr. C. O. Heilman, 807 Broadway, Fargo. Meetings by announcement. Annual session with State Medical Society in May, 1950, at Grand Forks, N.D.

Northern California Radiological Club
Secretary, Dr. R. L. Ayers, 726 4th St., Marysville, Calif. Meets at dinner last Monday, every second month, except June, July and August.

Ohio State Radiological Society
Secretary, Dr. E. C. Elsey, 927 Carew Tower, Cincinnati 2, Ohio.

Oklahoma State Radiological Society
Secretary, Dr. W. E. Brown, Tulsa, Okla. Three regular meetings annually.

Oregon Radiological Society
Secretary, Dr. Selma Hyman, Univ. of Oregon Medical School, Portland, Oregon. Meets monthly 2nd Wednesday, 8:00 P.M.

Orleans Parish Radiological Society
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

Pacific Northwest Radiological Society
Secretary, Dr. S. J. Hawley, 1320 Madison St., Seattle 4, Wash. Meets annually in May.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. J. M. Converse, 416 Pine St., Williamsport. Annual Meeting: Penn Harris Hotel, Harrisburg, Pa., May 12–13, 1950.

Philadelphia Roentgen Ray Society
Secretary, Dr. G. P. Keefer, 1930 Chestnut St. Meets first Thursday each month October to May, at 8:00 P.M., in Thomson Hall, College of Physicians.

Pittsburgh Roentgen Society
Secretary Dr. E. J. Euphrat, 3500 Fifth Ave., Pittsburgh 13, Pa. Meets 6:30 P.M. at Webster Hall Hotel on second Wednesday each month, October to May inclusive.

Queens Roentgen Ray Society
Secretary, Dr. J. E. Goldstein, 88-29 163rd St., Jamaica 3, N. Y. Meets fourth Monday of each month except during the summer.

Radiological Section, Baltimore Medical Society
Secretary, Dr. Harry A. Miller, 2452 Eutaw Place, Baltimore. Meets third Tuesday each month, Sept. to May.

Radiological Section, Connecticut Medical Society
Secretary, Dr. Fred Zaff, 135 Whitney Ave., New Haven, Conn. Meets bimonthly on second Wednesday.

Radiological Section, District of Columbia Medical Society
Secretary, Dr. K. C. Corley, 1835 Eye St., N. W., Washington, D. C. Meets Medical Society Auditorium, third Thursday, Jan., March, May, Oct. at 8:00 P.M.

Radiological Section, Southern Medical Association
Secretary, Dr. Roy G. Giles, Temple, Texas.

Radiological Society of New Jersey
Secretary, Dr. Benjamin Copleman, 280 Hobart St., Perth Amboy, N. J. Meets annually at Atlantic City at time of State Medical Society and mid-winter at Elizabeth, N. J.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. A. V. Winchell, 40 Meigs St., Rochester, N. Y. Meets monthly on last Monday from September through May, 8 P.M. at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary, Dr. Maurice D. Frazer, 1037 Stuart Bldg., Lincoln, Nebr.

St. Louis Society of Radiologists
Secretary, Dr. H. R. Senturia, Pasteur Medical Building, St. Louis, Mo. Meets fourth Wednesday each month, except June, July, August, and September.

San Diego Roentgen Society
Secretary, Dr. R. F. Niehaus, 1831 Fourth Ave., San Diego, Calif. Meets monthly, first Wednesday at dinner.

Section on Radiology, California Medical Association
Secretary, Dr. D. R. MacColl, 2007 Wilshire Blvd., Los Angeles 5, Calif.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. Harold L. Shinall, St. Joseph's Hospital, Bloomington, Ill.

Shreveport Radiological Club
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Carolina X-Ray Society
Secretary, Dr. T. A. Pitts, Baptist Hospital, Columbia, S. C. Meets in Charleston first Thursday in November, also with South Carolina State Medical Association.

Tennessee Radiological Society
Secretary, Dr. J. M. Frère, 707 Walnut St., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort Worth 4, Texas. Next meeting, Dallas, Texas, February 3 and 4, 1950.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 P.M., September to May inclusive. Room 203, Service Memorial Institute, 426 N. Charter St., Madison.

Utah State Radiological Society
Secretary, Dr. Angus K. Wilson, 343 S. Main St., Salt Lake City 1, Utah. Meets third Wednesday in September, November, January, March and May.

Virginia Radiological Society
Secretary, Dr. P. B. Parsons, Norfolk General Hospital, Norfolk, Va. Meets annually in October.

Washington State Radiological Society
Secretary, Dr. J. H. Walker, 1115 Terry Ave., Seattle 1, Wash. Meets fourth Monday each month, October through May, College Club, Seattle.

Wisconsin Radiological Society
Secretary, Dr. Irving I. Cowan, 425 E. Wisconsin Ave., Milwaukee 2, Wis. Special meetings held during year; annual meeting each spring at Madison, Wis.

X-Ray Study Club of San Francisco
Secretary, Dr. W. F. Reynolds, University of California Hospital, San Francisco. Meets from January to July at Lane Hall, Stanford University Hospital, and from July to December at San Francisco Hospital.

Cuba

Sociedad de Radiología y Fisioterapia de Cuba
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

Mexico

Sociedad Mexicana de Radiologia y Fisioterapia
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Ordinary meeting, on the Thursday preceding the third Friday, October to May at 8:15 P.M.
Medical Members' meeting, on third Friday in each month at 5:00 P.M., 32 Welbeck St., London, W 1.

Faculty of Radiologists
Honorary Secretary, Dr. J. F. Bromley, 45, Lincoln's Inn Fields, London, W.C.2, England.

Section of Radiology of the Royal Society of Medicine (Confined to Medical Members)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London.

Canadian Association of Radiologists
Honorary Secretary, Dr. E. M. Crawford, 1535 Sherbrooke St., West, Montreal 26, Que. Meetings January and June.

Section of Radiology, Canadian Medical Association
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

Société Canadienne-Française d'Electrologie et de Radiologie Médicales
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

Australian and New Zealand Association of Radiologists
Honorary Secretary, Dr. Alan R. Colwell, 135 Macquarie St., Sydney, N.S.W.
Honorary Secretaries, State Branches:
New South Wales, Dr. E. W. Frecker, 135 Macquarie St., Sydney.
Victoria, Dr. T. I. Tyrer, 3 Lockerbie Court, East St. Kilda.
Queensland, Dr. J. Adam, 131 Wickham Terrace, Brisbane.
South Australia, Dr. R. de G. Burnard, 170 North Terrace, Adelaide.
Western Australia, Dr. A. M. Nelson, 179-B St. Georges Terrace, Perth.
New Zealand, Dr. E. G. Lynch, 12 Bolton St., Wellington.

South America

Asociacion Argentina de Radiologia
Secretary, Dr. Lidio G. Mocsa, Avda. Gral Paz 151, Córdoba, Argentina. Meetings held monthly.

Sociedad Argentina de Radiologia
Secretary, Dr. Guido Gotta, Buenos Aires, Argentina. Meetings are held monthly.

Sociedad Argentina de Radiología, Filial del Litoral
President, Dr. Francisco P. Cifarelli. Meets monthly second Wednesday, 7:00 P.M., 663 Italia St., Rosario.

Sociedade Brasileira de Radiologia Medica
Secretary, Dr. Nicola Caminha, Av. Mem de Sa, Rio de Janeiro, Brazil. Meets monthly, except during January, February and March.

Sociedade Brasileira de Radioterapia
Secretary, Dr. Oscar Rocha von Pfuhl, Av. Brigadeiro Luiz Antonio, 644 São Paulo, Brazil. Meets monthly on second Wednesday at 9 P.M. in São Paulo at Av. Brigadeiro Luiz Antonio, 644.

Sociedad Peruana de Radiologia
Secretary, Dr. Julio Bedoya Paredes, Apartado, 2306, Lima, Peru. Meets monthly except during January, February and March, at Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

Sociedad de Radiologica, Cancerologia y Fisica Medica del Uruguay
Secretary, Dr. Arias Bellini.

Continental Europe

Société Belge de Radiologie
General Secretary, Dr. S. Masy, 111 Avenue des Alliés, Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

Ceskoslovenská společnost pro röntgenologii a radiologii v Praze
Secretary, Dr. Roman Bláha, Praha XII, stát. nemocnice, Czechoslovakia. Meets monthly except during July, August, and September. Annual general meeting.

Polish Society of Radiology
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland.

Gdansk Section, Polish Society of Radiology
Secretary, Dr. A. Smigielska, Akademia Lekarska, Gdansk. Meets monthly last Sunday at 10.30, X-Ray Dept., Akademia Gdansk.

Warsaw Section, Polish Society of Radiology
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland. Meets monthly.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Oscar Meller, Str. Banual Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad. USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

Leningrad Roentgen Ray Society
Secretaries, Drs. S. G. Simonson and G. A. Gusterin. Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

Moscow Roentgen Ray Society
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky. Meets monthly, first Monday, 8 P.M.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

Sociedad Espanola de Radiologia y Electrologia
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

Schweizerische Röntgen-Gesellschaft (Société Suisse de Radiologie)
Secretary, Dr. Max Hopf, Effingerstrasse 47, Bern, Switzerland.

Societa Italiana di Radiologia Medica
Secretary, Prof. Mario Ponzio, Ospedale Mauriziano. Torino, Italy. Meets biannually.

AVAILABILITY OF CALIBRATED SOLUTION STANDARDS OF I^{131} AND P^{32}

The National Bureau of Standards is continuing its program of periodical distribution of calibrated solution standards of I^{131} and P^{32}. The distribution of solution standards of P^{32} took place on March 1, 1950. The solution will be approximately 3 ml. of 0.001 M/H_3PO_4 in a flame-sealed glass ampule. The activity will be approximately 100,000 disintegrations per second per milliliter and the actual activity per milliliter of the standards as of the reference date will be clearly indicated on the ampule. The National Bureau of Standards is limited by the Atomic Energy Commission to distributing a total of 10 microcuries of total activity to a single laboratory. However, where a laboratory requires greater concentration or total activity for their measurements, prior authorization should be obtained from the Atomic Energy Commission.

Upon the receipt of a request and the authorization from the Atomic Energy Commission, the National Bureau of Standards will furnish approximately the activity desired. The fee for the service will be $5.00 for a 3 milliliter sample for those laboratories which are normally charged. A notice will be sent to the purchaser on the date of shipment advising of the actual dispatch.

There is no obligation on the part of the laboratory to recalibrate the solutions and report their findings to the Bureau. However, many laboratories will use these solution standards as a check on their methods of calibration of their own P^{32} samples. In these cases the Bureau would appreciate receiving a report of the measured activity. The Bureau is especially interested in the reports from laboratories using absolute methods of calibration.

In order that the Bureau may establish a suitable distribution list and in order that laboratories be included in future notices concerning solution standards, a letter from those interested should be sent to the Radioactivity Section of the National Bureau of Standards, Washington, D. C.

TESTIMONIAL DINNER

A testimonial dinner was given at the Barclay Hotel, Philadelphia, by the Philadelphia Roentgen Ray Society on March 23, 1950, to honor Dr. Bernard P. Widmann, President-Elect of the American Roentgen Ray Society, and Dr. Barton R. Young, Secretary, American Roentgen Ray Society. The dinner was attended by 125 members of the Philadelphia Roentgen Ray Society and other friends of the honored guests. Silver pitchers suitably inscribed were presented to Dr. Widmann and Dr. Young.

DIAGNOSIS AND THERAPY OF CANCER

A Post-Graduate Medical Course on "Diagnosis and Therapy of Cancer: Clinical Surgery, Radiation Therapy, Endocrine Therapy" will be given by University Extension and the School of Medicine, University of California, at Los Angeles, California, July 17–22, 1950. The course is open only to graduates of medical schools approved by the Council on Medical Education and Hospitals of the American Medical Association. Requests for information concerning the course should be made to: Office of Medical Extension, University Extension, University of California, Los Angeles 24, California.

ATLANTA RADIOLOGICAL SOCIETY

At the March, 1950, meeting of the Atlanta Radiological Society the following new officers were elected: *President*, Dr. William W. Bryan; *Vice-President*, Dr. George Hrdlicka; *Secretary-Treasurer*, Dr. Ted F. Leigh.

MINNESOTA RADIOLOGICAL SOCIETY

The winter meeting of the Minnesota Radiological Society was held at Rochester, Minnesota, on March 25, 1950. The following scientific program was presented:

Eventration—Dr. J. W. Beeler

Bezoars—Dr. R. L. Tondreau and Dr. B. R. Kirklin

Aberrant Vessels of the Lung—Dr. A. Bruwer
Chronic Granulomata of the Lung—Dr. C. A. Good
Metabolic Effects of Radiation—Dr. D. S. Childs, Jr.
Back and Sciatic Pain from Causes other than Disc—Dr. H. H. Young.
Presentation of Interesting Cases
Demonstration of Angiocardiographic Unit—Dr. D. G. Pugh

The program was followed by a business meeting and dinner.

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY

The annual mid-summer conference of the Rocky Mountain Radiological Society will be held in Denver, Colorado, at the Shirley-Savoy Hotel on August 17, 18 and 19. An excellent program is being arranged.

BOOK REVIEWS

Books sent for review are acknowledged under: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interest of our readers as space permits.

Le Diagnostic bio-clinique en Radiologie pulmonaire. By Georges Voluter, P. D. de Radiologie médicale à l'Université de Genève. Paper. Price, Swiss fr. 40. Pp. 452, with 100 illustrations. Basle: S. Karger Ltd., 1949.

Here is a book that certainly merits translation into an English edition for it should be of genuine interest to American clinicians, radiologists, pathologists, and thoracic surgeons, in short, the "entire team." It is no atlas of roentgenograms portraying lung pathology of all pulmonary diseases and listing the findings of the cadaver lung at autopsy. It is a study from the first page to the last of the living, vital, *pathologico-physiological* changes in the lung in disease as manifested by predominant alterations in either alveolar, interstitial or bronchial tissues of the lung; and not one of the 100 beautifully reproduced illustrations is wasted in demonstrating this most graphically. One of the unusual features of this book is the brilliant way in which the roentgen method is used as an instrument of research in the study of living changes in each of the special tissues in the lung.

The book is divided into three parts with a fourth part on Endothoracic Biopsy written in collaboration with Dr. A. Calame. Part I treats of "Qualitative Diagnosis" best defined by what it is not. Not a descriptive, static, solely morphological observation of pulmonary changes but complete correlation of clinical data, laboratory data, serial chest films taken at necessary intervals over the evolutionary course of the disease, tomographic studies, and every means of studying the lung biologically is the author's meaning of the term "qualitative diagnosis" or "bio-clinical diagnosis"; and Part I contains detailed analyses of roentgen morphology and the *changing* pulmonary roentgenogram in exudative, follicular and fibrous processes. Part II, the longest section, is devoted to the changing roentgen morphology and *physiological* pathology in the parenchyma of the lung in blood-borne, lymph-borne, and air-borne pulmonary lesions. Part III treats of the bio-clinical aspects and problems in many different syndromes, such as allergic states and hypersensitivity phenomena, erythema nodosum, Löffler's syndrome, various granulomas, and the pneumoconioses. The last 72 pages of this section are devoted to pneumoconioses and 52 of these pages to silicosis. This précis on silicosis is worth the price of the book. Part IV discusses all aspects of endothoracic biopsy.

The radiologist who reads this book will find on every page adequate demonstration that he, himself, is first a physician and second a radiologist. Best of all, he will have less use for and less sympathy with the word "atypical" in his roentgen reports of chest pathology and in his conferences.

William M. Loehr, M.D.

Estudio Radiológico del Intestino Delgado. By Dr. C. Marina Fiol, Medical Clinic of the Faculty of Medicine of Madrid and of the Institute of Medical Investigation of Professor C. Jiménez Diaz. Preface by Professor C. Jiménez Diaz. Price, 190 pesetas. Pp. 415, with 514 illustrations. Madrid: Editorial Paz Montalvo, 1949.

It is very gratifying to receive for review a copy of this work on the small intestine. The general make-up of the book at once commands attention and a review of its pages leaves one impressed very favorably with the quality of the numerous roentgenographic illustrations. The author has discussed the history and technique of roentgenological examination and the roentgenological anatomy of the small intestine. He evidently found difficulty in determining just where the jejunum ends and the ileum begins. He, however, distinguishes primarily the proximal jejunum, the terminal jejunum, the proximal ileum, the pelvic ileum and finally the terminal ileum. Careful description of these segments of the small intestine is given, together with many illustrations.

The movement of the small intestine next engages the attention, commencing with the work of Cannon, including both his early and his late investigations, and a careful review of all observations down to the present date. In a study of fifty cases, the author found the cecum beginning to fill within three or three and a half

hours in 43 per cent of cases, and by the fourth hour in 80 per cent of cases; in only one case as long as six hours.

It seems that the author can have omitted very little in his attempt to make this work a complete discussion of the small intestine. He has not dilated at great length on the disturbances of various vitamin lacks in the diet as have some American writers. Even to one who does not read Spanish the work would be of interest and value because of the numerous, well-produced illustrations and the fact that anyone who has studied Latin should be able to make approximate interpretation of the captions.

James T. Case, M.D.

X-Ray Treatment: Its Origin, Birth and Early History. By Émil H. Grubbé, B.S., M.D., F.A.C.P., Charter Member and Emeritus Member of the Radiological Society of North America; Charter Member of the American Roentgen Ray Society; etc. Cloth. Pp. 153, with 51 illustrations. St. Paul: The Bruce Publishing Company, 1949.

This book of 153 pages with 51 illustrations will be of greatest interest to the older men who have themselves pioneered in the use of the roentgen ray in medicine, although any who are historically minded will find here a dramatic story of the early days following Röntgen's epoch-making discovery. Written for the most part in autobiographical form, Dr. Grubbé gives an exciting account of how he was among the first to be able to duplicate Röntgen's experiments and produce x-rays. When the details of Röntgen's discovery reached Chicago, Émil Grubbé was a chemist, assayer of rare metals and manufacturer of incandescent lamps, Geissler and Crookes tubes. He also had an air pump for evacuating the tubes, an electric current generator, a Ruhmkorff induction coil and a supply of platinum with which to make the platinocyanide coated fluorescent screens. With the aid of a German technician and glass-blower, Albert Schmidt, he quickly reproduced Crookes tubes of a design first suggested by Sir Herbert Jackson in 1894, having a concave cathode to focus the cathode-ray stream on an anode of platinum placed at a 45 to 60 degree angle. This tube proved to be a rich source of roentgen rays and Grubbé tested the degree of evacuation of the various tubes by placing his hand between the activated Crookes tube and a hand fluoroscope made from a hat box. Since his left hand was generally used for this purpose it is not surprising that after several weeks' exposure extreme inflammatory symptoms developed.

During this time, in addition to his other activities, Dr. Grubbé was an under-graduate medical student at Hahnemann Medical College in Chicago. Doctors whom he consulted correctly assumed the dermatitis to be the result of roentgen rays and several suggested the possibility of therapeutic application of the rays. This, he declares, was the origin of roentgen therapy. It was then that the first patient was sent to Dr. Grubbé for treatment. She was a woman suffering from advanced ulcerating carcinoma of the breast. Treatment was undertaken and, thoughtfully, the surrounding healthy tissues were protected by sheets of lead taken from an old Chinese tea chest. This treatment given on Jaunary 29, 1896, marked the birth of roentgen therapy.

The author opened what he believes to be the first roentgen therapy laboratory in the world at 2614 Cottage Grove Avenue, Chicago, in February, 1896. After his graduation in medicine, Dr. Grubbé was appointed Professor of Roentgenology at Hahnemann Medical College, Chicago, in what he asserts to be the first Chair of Roentgenology so established in the world. During the years, Dr. Grubbé has suffered the loss of his left hand and his upper lip from his early use of roentgen rays without protection. He has had eighty-three operations to relieve discomfort and to control the deleterious effects of these burns. From his own experiences he advises that there should be no delay in excising, or amputating where necessary, to remove a degenerated area. Many of the early roentgen-ray workers died, in his opinion, because they would not permit these radical surgical procedures to be performed in time.

As noted above, Dr. Grubbé first improvised sheets of lead from old Chinese tea chests to protect the healthy tissues around the area to be treated. Since such lead oxidized readily and soon became dirty, he worked out a formula of 5 per cent tin and 95 per cent lead from which to make a thin sheet marketed as "Grubbe X-Ray Foil" and which proved useful in masking lesions under treatment. Dr. Grubbé devised a roentgen-ray carriage for use in a hospital to carry his roentgen-ray machine to

patients too ill to come to him for therapy. By means of his compression and deep tissue treatment localizer, he was able to treat segments of a 9½ inch circle amounting to one-sixth of the area at a time, thus giving heroic doses without too much damage to the skin. This he claims to be, in all probability, the device leading to "different ports of entry" technique. He designed a water cooled cavity therapy tube, fluoroscopic and roentgenographic tubes, all before the advent of the Coolidge hot filament tube. An important contribution was his design of a three panel protective screen with a lead glass window. He also was among the first to utilize aluminum and copper filters to increase penetration of the roentgen-ray beam.

Several of Dr. Grubbé's early tubes, and documentary evidence to support his claims of priority in the therapeutic use of roentgen rays, are preserved in the Smithsonian Institution, Washington, D.C. There is also a permanent exhibition of much of his early equipment at the Museum of Science and Industry, Chicago.

In this book the author lists many of the diseases found amenable to roentgen irradiation and credits various originators of specific techniques. He tells of the apathy of surgeons in accepting this modality in the earlier days. Also given are the names of American and foreign pioneers and martyrs in development of roentgen therapy. It is indeed remarkable that Émil Grubbé, among the first to use roentgen rays, has survived to the ripe age of seventy-five.

For an evening of enlightening and entertaining reading on the history of the roentgen ray, this book by the original roentgen therapist is highly recommended.

Lewis E. Etter, M.D.

Medical Photography—Radiographic and Clinical. By T. A. Longmore, Hon. F.S.R., Principal, Kodak School of Medical Radiography and Clinical Photography, Hon. Editor of "Radiography," Member of Council, Education Committee and Board of Examiners of the Society of Radiographers, etc. Fourth edition. Cloth. Price 50/ net. Pp. 1,008, with 120 illustrations and 320 diagrams. London: The Focal Press, 1949.

Medical Photography—Radiographic and Clinical presents a most illuminating exposition on the fundamentals of roentgenographic exposure. A clear interpretation of roentgenographic phenonema is authoritatively laid before the reader. The exposure response of film to roentgen rays, the function of the various exposure factors in producing certain roentgenographic effects on the image, the chemistry and procedure of standardized processing of the roentgen film are all ably described. Assimilation of the roentgenographic facts presented in this book would do much toward improving the over-all roentgenographic quality in any laboratory.

To those interested in clinical photography, the purpose and scope of this endeavor is well presented. The principles of photography, processing solutions, cameras, exposure and processing of the films, plates and paper are concisely and thoroughly described. The modern applications of photography are many and varied and it is most fortunate that they are briefly though thoroughly described by Mr. Longmore—an outstanding authority on the subject.

The wealth of factual data is startling and one cannot help but be enthusiastic about this book despite its rather ambiguous format. Roentgenography and clinical photography are separate entities even though the principles of each may be intertwined. Dividing the subject matter into two books would have greater appeal and usefulness to specialists in either the field of roentgenography or that of clinical photography. As a teaching text, it is outstanding.

Arthur W. Fuchs

Annual Report on the Results of Radiotherapy in Cancer of the Uterine Cervix. Fifth Volume. Statements of Results Obtained in 1941 and Previous Years (collated in 1948). Sponsored by The British Empire Cancer Campaign, London; The Donner Foundation, Philadelphia; The Cancerföreningen, Stockholm; The World Health Organization. Editorial Committee: Dr. J. Heyman (Editor), Stockholm; Dr. M. Donaldson, London; and Dr. L. C. Scheffey, Philadelphia. A French edition of this Report is available. Paper. Pp. 245, with numerous tables. Stockholm: P. A. Norstedt & Söner, 1949.

This volume is the fifth edition of a survey of the results obtained with the radiation treatment of cancer of the cervix on an international

basis. The criteria for reporting cases of cancer of the cervix in a uniform manner are given in detail and preliminary notes are included on a plan for classifying malignant tumors involving the corpus uteri, vagina and ovary to be reported in the future.

The material presented includes detailed statements from twenty-four radiotherapeutic centers in eight different countries. When combined with the four previous reports, the available information concerns 33,293 patients suffering from cancer of the uterine cervix. Of this entire group 30,299 cases were treated with irradiation alone with a relative five year cure rate of 30.9 per cent. A review of the figures from different clinics reported since 1931 indicates a slow but steady improvement in the cure rate. A careful study of 7,675 cases treated from 1936 to 1941 by ten centers reveals a relative five year cure rate of 37.8 per cent. The data from these centers were selected for this study because they were complete and included absolute figures. This monograph is the most comprehensive review of the radiation treatment of cancer of the cervix ever compiled.

Charles L. Martin, M.D.

Cancer of the Uterine Cervix. Clinical Features with Particular Reference to the Results of Radiotherapy. A Report of 2,918 Cases. By Frithiof Truelsen. Paper. Price, 25 Dan. Kr., bound 29 Dan. Kr. Pp. 440, with numerous tables and graphs. Copenhagen: Rosenkilde and Bagger; London: H. K. Lewis & Co., Ltd., 1949.

This is a very comprehensive monograph dealing with all clinical phases of cancer of the uterine cervix and its treatment as practiced at the Radium Centre in Copenhagen, Denmark. The material on which the study is based comprises 2,918 cases treated during the period from 1922 to 1939 inclusive. To obtain a true picture of the situation only the untreated primary lesions are considered. The cases in which radiation therapy was started elsewhere and the recurrences following surgery are omitted. An excellent follow-up of more than 99 per cent was secured for the five and ten year periods, and of 98 per cent for the fifteen year period.

The treatment consisted of radium exclusively from 1922 to 1937 and of an association of radium and deep roentgen therapy in 1938 and 1939. A modified Stockholm technique was used for the application of the radium, which was placed both in the uterine cavity and vagina. Given in two sittings, the intrauterine dose amounted to 2,600 millicurie hours, and the intravaginal dose to 4,000 milligram hours. After 1937, when a combination of radium and deep roentgen therapy was used, the radium dose became more individualized. The roentgen therapy was carried out with 180 kv., 0.5 mm. Cu, corresponding to a half-value layer of 0.9 mm. Cu.

In the group of 2,450 cases treated with radium alone the absolute cure rate was: 28.6 per cent at the five year, 23.6 per cent at the ten year and 13.9 per cent at the fifteen year period. In the group of 468 cases which were treated by an association of radium and deep roentgen therapy 42.3 per cent survived five years, being apparently free of the disease.

In presenting this material, the author gives very detailed statistical compilations in relation to various factors which may influence the survival curves of final results. He also makes a very extensive use of the data collected from the literature. Reference is made to no less than 505 articles, including practically all the salient international publications on the subject. In an appendix the 2,918 cases are tabularly arranged, the important features of each patient being indicated by a number of code figures and letters, comprising a total of seventeen columns.

T. Leucutia, M.D.

Pharmacology and Toxicology of Uranium Compounds. (With a Section on the Pharmacology and Toxicology of Fluorine and Hydrogen Fluoride.) Edited by Carl Voegtlin, Ph.D., formerly Chief of the Division of Pharmacology, National Institute of Health. U. S. Public Health Service; etc.; and Harold C. Hodge, Ph.D., Professor of Pharmacology and Toxicology, School of Medicine and Dentistry, University of Rochester. Two parts. Cloth. Price, $10.00. Pp. 1,084, with numerous illustrations and tables. New York: McGraw-Hill Book Company, Inc., 1949.

These volumes are a record of part of the research undertaken by the University of Rochester on behalf of the Manhattan Project and its successor, the Atomic Energy Commission.

The scientific material is preceded by very interesting and illuminating introductory articles by A. H. Dowdy, Carl Voegtlin and H. C.

Hodge on the organization of the investigating groups, on the description of their aims and the assignment of their task.

Comprehensive investigations on the pharmacology and toxicology of uranium compounds are presented in sixteen chapters totalling a thousand pages. The subject matter is covered in logical sequence from the chemistry of uranium compounds to studies on human exposure. Part II deals with some toxicological problems following the inhalation of fluorine and hydrogen fluoride. Because of the thoroughness of approach and the competence of the authors, these volumes will remain unchallenged for many years as the authoritative expression of most of our present knowledge on this subject.

L. D. Marinelli

BOOKS RECEIVED

Practical Neurological Diagnosis. With Special Reference to the Problems of Neurosurgery. By R. Glen Spurling, M.D., Clinical Professor of Surgery (Neurosurgery), University of Louisville School of Medicine, Louisville, Kentucky. Fourth edition. Cloth. Price, $5.00. Pp. 268, with 101 illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1950.

Bronchography. By Eelco Huizinga, M.D., and G. J. Smelt, M.D., Department of Oto-Rhino-Laryngology, University of Groningen. Cloth. Pp. 270, with about 150 illustrations. Van Gorcum & Comp. Ltd. (G. A. Hak & H. J. Prakke), Aan den Brink—Assen, Netherlands, 1949.

Røntgenundersøkelser ved akutte abdominalsykdommer. En laerebok. Av J. Frimann-Dahl, Overlege dr. med Ullevål Sykehus, Oslo. Paper. Price, kr. 22.–. Pp. 280, with 219 illustrations. Johan Grundt Tanum, Oslo, Norway, 1942.

Urologic Roentgenology. By Miley B. Wesson, M.D., Past President American Urological Association. Third edition, thoroughly revised. Cloth. Price, $7.50. Pp. 282, with 284 illustrations. Lea & Febiger, Washington Square, Philadelphia 6, Pennsylvinia, 1950.

L'Organisation des Os. Par Pierre Lacroix, Professeur à la Faculté de Médecine de Louvain. Paper. Price, 900 fr. Pp. 230, with 87 illustrations. Éditions Desoer. Hiège. Masson et Cie, 120, boulevard Saint-Germain, Paris 6e, France, 1949.

Les Tumeurs Malignes des Voies Aéro-Digestives Supérieures. Par J. Ducuing, Professeur de Clinique Chirurgicale et du Cancer, Directeur du Centre Anti-Cancéreux de Toulouse; et L. Ducuing, Ancien Laryngologiste du Centre Anti-Cancéreux de Toulouse. Paper. Price, 2000 fr. Pp. 582, with 170 illustrations. Masson et Cie, 120, boulevard Saint-Germain, Paris 6e, France, 1949.

Cancer of the Uterine Cervix. Clinical Features with Particular Reference to the Results of Radiotherapy. A Report of 2,918 Cases. By Frithiof Truelsen. Paper. Price, 25 Dan. Kr., bound 29 Dan. Kr. Pp. 440, with numerous tables and graphs. Rosenkilde and Bagger, Copenhagen, Denmark; H. K. Lewis & Co., Ltd., 136 Gower Street, London W. C. 1, England, 1949.

Annual Report on the Results of Radiotherapy in Cancer of the Uterine Cervix. Fifth Volume. Statements of Results Obtained in 1941 and Previous Years (collated in 1948). Sponsored by The British Empire Cancer Campaign, London; The Donner Foundation, Philadelphia; The Cancerföreningen, Stockholm; The World Health Organization. Editorial Committee: Dr. J. Heyman (Editor), Stockholm; Dr. M. Donaldson, London; and Dr. L. C. Scheffey, Philadelphia. A French edition of this Report is available. Paper. Pp. 245, with numerous tables. P. A. Norstedt & Söner, Stockholm, Sweden, 1949.

Vacuum Equipment and Techniques. National Nuclear Energy Series. Manhattan Project Technical Section. Division I—Volume 1. Edited by A. Guthrie, Ph.D., Radiation Laboratory, Department of Physics, University of California; and R. K. Wakerling, Ph.D., Radiation Laboratory, Department of Physics, University of California. First edition. Cloth. Price, $2.50. Pp. 264, with numerous illustrations. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, New York, 1949.

The Characteristics of Electrical Discharges in Magnetic Fields. National Nuclear Energy Series. Manhattan Project Technical Section. Division I—Volume 5. Edited by A. Guthrie, Ph.D., Radiation Laboratory, Department of Physics, University of California; and R. K. Wakerling, Ph.D., Radiation Laboratory, Department of Physics, University of California. First edition. Cloth. Price, $3.50. Pp. 376, with numerous graphs and tables. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, New York, 1949.

ABSTRACTS OF RADIOLOGICAL LITERATURE

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ROENTGEN DIAGNOSIS

HEAD

Wickbom, Ingmar. Angiography in posttraumatic intracranial hemorrhages. *Acta radiol.*, 1949, *32*, 249–258.

For the most part the extradural hematomas give the same arteriographic picture as the subdural hematomas displacing the vessels from the vault. These hematomas usually lie above the temporal lobe and are due to a fracture which has crossed the middle cerebral artery. These peripherally situated hematomas may also be associated with a contusion or hematoma within the temporal lobe. Roentgenologically, the latter lesions can be distinguished from the subdural hematomas only if they are high up and reach the midline. In this location, the superior longitudinal sinus is displaced making their recognition possible.

Uncomplicated hematomas, intracerebrally located, usually occur in the frontal or temporal lobe and at angiography show the same changes as tumors and other expanding processes. Accordingly, these hemorrhages cannot be distinguished from brain tumors by angiography alone.

In summary, it may be said that cerebral angiography demonstrates well any gross anatomical changes which occur subsequent to skull injury. It is a more valuable procedure than exploratory drilling because it gives some information as to the presence of intracerebral as well as extracerebral injury.—*Mary Frances Vastine, M.D.*

Jaeger, Rudolph. Aneurysm of the intracranial carotid artery; syndrome of frontal headache with oculomotor nerve paralysis. *J.A.M.A.*, Feb. 4, 1950, *142*, 304–310.

This is a critical analysis of 31 consecutive cases of aneurysm of the intracranial carotid artery, the chief features of which were oculomotor paralysis or paresis associated with frontal or orbital head pains. These symptoms are sufficient to permit a presumptive diagnosis of aneurysm of the intracranial carotid artery. The clinical diagnosis in 31 patients (4 males and 27 females ranging in age from nineteen to seventy years) was based primarily on these two symptoms and all were proved either by arteriography or operative procedure, or in many of them by both. Operative results in 26 patients are discussed.

The optic, oculomotor, trochlear, abducens and trigeminal nerves lie within an inch radius of the intracranial portion of the carotid and may be involved by an aneurysm. The oculo-

motor being more closely situated is the most commonly damaged, hence the early oculomotor palsy seen with these lesions. Unilateral-frontal and periorbital pain is a common finding but of the 31 patients 3 had no unilateral frontal pain and 3 had no oculomotor paralysis as exceptions. Sixteen patients had generalized headaches, 5 had meningismus with blood in the spinal fluid, 4 had gross frank bloody spinal fluid and 2 had contralateral hemiparesis.

Plain roentgenography is of little value, but arteriography by injection of contrast material into the internal carotid artery will usually show the location and type of the lesion.

Treatment was by direct approach (craniotomy) in 20 patients with an operative mortality of 25 per cent in order to obtain a permanent cure. It is concluded that all adults with persistent frontal and orbital pain or ache associated with third nerve paresis or paralysis should be suspected of having an aneurysm of the internal carotid artery. Arteriography is indicated to confirm the diagnosis, localize the lesion, and to determine the feasibility for direct surgical treatment. Most of these patients can be relieved or cured by surgery without great or unnecessary risk.—*R. K. Arbuckle, M.D.*

Wilson, T. G. Chronic nasal sinusitis in children. *Irish J.M.Sc.*, Feb., 1950, *6*, 83–87.

This is a report of 735 children referred to the X-Ray Department of the Irish National Children's Hospital for examination of the paranasal sinuses, of whom 571, or roughly 75 per cent, were diagnosed as pathological. Five hundred and eighty children were admitted to the same hospital for the removal of tonsils and adenoids. Of these, 27 per cent were found to have pathology in their paranasal sinuses.

The author feels that paranasal sinus disease is more common in children than in adults. Also the treatment is less satisfactory in children. An excellent description of the development of the paranasal sinuses from birth to the age of twelve is given. Numerous suggestions as to the etiology of this condition are also given, the most important of which, according to the author, is chronic pharyngeal infection and allergy. Birth trauma should also be considered as an etiological factor.

The author points out that transillumination is frequently very fallacious in children and that roentgenograms are perhaps too sensitive a diagnostic measure.

The use of both conservative and radical surgery is given, and the author states that he has not used radiotherapy.

The author further states that otitis media is associated with paranasal sinusitis in a high percentage of cases, but the most interesting group is that of the upper respiratory infections with associated bronchiectasis, in which he points out that frequently the diseased lung is felt to be secondary to the paranasal sinus disease. He further states that it is frequently impossible to decide whether the bronchiectasis or the sinusitis came first, although he feels that the sinusitis normally precedes the bronchiectasis. However, cases have been reported of sinusitis with bronchiectasis which cleared following lobectomy.—*E. L. Pirkey, M.D.*

Engstrom, Arne, Hamberger, C. A., and Welin, Solve. A roentgen ray microspectrographic investigation of the inflammatory destruction of the mastoid bone. *Brit. J. Radiol.*, June, 1949, *22*, 309–324.

In an attempt to establish criteria for the interpretation of roentgenograms of mastoids, to aid in determining the presence or absence of mastoiditis when clinical signs are masked, as with chemotherapeusis, minute fragments of bone removed at operation were compared with normal bone removed during fenestrations for otosclerosis. These fragments were examined by roentgen-ray microspectrography. The results were applied to the roentgen findings and correlated with the pathological changes found at operation.

It was demonstrated that if the mastoid cell walls are thicker than 0.3 mm., and there is decreased contrast of the mastoid structure in roentgenograms, this decreased contrast indicates the evidence of bone involvement by the disease. If the mastoid cell walls are less than 0.3 mm. in thickness, decreased contrast in roentgenograms does not necessarily indicate bone involvement, as the decrease in contrast may be produced by edema of the mucous membrane or by the presence of exudate within the cells.—*E. F. Lang, M.D.*

Kristiansen, Kristian. Cerebral angiography in the diagnosis of intracranial hematomas. *Surgery*, Nov., 1948, *24*, 755–768.

The value of percutaneous cerebral angiography as an aid in the diagnosis of acute in-

juries to the head is discussed. Injuries to the head without fracture of the skull have rarely proved fatal in the author's experience. The presence of a fracture indicates the site of a certain degree of violence and may indicate the side of the hemorrhage. Displacement of the pineal calcification, however, is a more reliable indication regarding hemorrhage although displacement may be due to the presence of edema unilaterally. The effect of dehydration therapy is of value in the differentiation of cerebral edema and intracranial hematoma for both show similar clinical manifestations. Progressive drowsiness which may be combined with motor restlessness, stupor or coma and which does not respond to dehydration therapy is the chief indication for surgical intervention. In general, the differential diagnosis includes one or more of the following: (1) extradural hematoma; (2) subdural hematoma; (3) intracerebral hematoma; (4) contusion and laceration with cerebral edema.

Percutaneous carotid angiography is of value in ascertaining the nature and location of an intracranial lesion after it is determined that unconsciousness or impaired consciousness is due to an intracranial injury. In the author's experience no serious complications have arisen. A solution of diodrast in a 35 per cent concentration is used.

The angiographic manifestations in a case of subdural hematoma are summarized. There was a lack of contrast medium between the skull and the surface of the brain and displacement of the anterior cerebral artery to the uninvolved side. Repeated angiography after removal of the hematoma demonstrated regression of the cavity and return of the displaced anterior cerebral artery toward its normal position. Another case is presented which illustrates that in cases in which a clinical diagnosis of subdural hematoma is made and in which a clinical diagnosis of subdural hematoma is made and in which a cerebral angiogram does not demonstrate abnormalities, the lesion is probably located in the posterior fossa or in the posterior occipital region.

Three cases of acute traumatic intracerebral hematomas are reported. In each of 2 cases it was noted that cerebral angiography indicated traumatic hematoma in the temporal region of the patient by elevation and medial displacement of the sylvian group of vessels on the affected side and displacement of the anterior cerebral artery to the opposite side. Because the results of surgical treatment are good for these types of intracranial hematomas, it is suggested that this method of diagnosis and treatment may be of use in suitable cases of ordinary cerebral hemorrhage or apoplexy. The author states that in cases in which operation is indicated for acute injuries to the head, craniotomy should be performed as a burr hole which is enlarged only enough for evacuation of the hematoma and for hemostasis.—*C. B. Holman, M.D.*

Le Beau, J., and Rosier, M. Les abcès du cerveau d'origine métastatique. (Brain abscess of metastatic origin.) *Rev. neurol.*, May, 1949, *81*, 343–351.

The author observed a total of 70 cases of intracranial abscess since November, 1944, the time of introduction of penicillin. Of these, 55 represented cases of brain abscess and 15 of meningeal abscess. Approximately one-third of the brain abscesses were of metastatic origin.

The etiology, bacteriology, anatomic location, evolution, and surgical treatment of the brain abscess of metastatic origin are discussed in detail.

The following general conclusions are reached:

(1) A brain abscess is suspected whenever localizing signs or an increased intracranial pressure appear during the course of a subacute pulmonary infection. If no bacteria are demonstrated by lumbar puncture, a brain abscess is probable. If there are bacteria present but the intraspinal administration of penicillin fails to produce improvement, likewise one must think of the possibility of a brain abscess.

(2) To localize the abscess a cerebral puncture is performed through the trephine opening, the site of which depends on the neurologic signs. The abscess is evacuated and 20,000 to 50,000 units of penicillin are injected.

(3) The authors do not recommend systematically the injection of an opaque liquid since it is impossible to inject all loculations. Ventriculography is dangerous especially in the acute cases.

(4) Generally, daily doses of 200,000 to 400,000 units of penicillin are given for about one week, or longer if the pulmonary infection persists.

(5) If the brain abscess is chronic or subacute, complete removal without drainage is performed immediately. A dose of 20,000 to

50,000 units of penicillin is injected in the wound and, if the ventricle has been opened, through lumbar puncture for four or five days.

(6) If the abscess is acute it is advisable to wait twenty-four hours and observe the effect of the aspiration and the penicillin. If there is no improvement, as is usually the case, a complete removal of the abscess is performed the next day in a manner similar to that practiced in the chronic cases. If there is improvement, one may wait for a more favorable situation before proceeding with the operation.

(7) If the abscess has healed and there are neurologic sequelae, ventriculography may be of value in demonstrating a residual focus. One should also pay attention to the pulmonary infection.—*T. Leucutia, M.D.*

NECK AND CHEST

Handousa Bey, A. S. Some rare anomalies of the oesophagus; with discussion of their aetiology. *J. Laryng. & Otol.*, April, 1949, *63*, 217–224.

Four cases of rare esophageal anomalies are reported.

The first case is that of diverticulosis of the upper esophagus. A twenty year old female was seen with a one week history of dysphagia following accidental swallowing of a large medallion. There was no previous history of feeding difficulty or inflammatory disease of the neck. Roentgen examination showed a foreign body opposite D2 and D3. The foreign body was removed endoscopically and a complete roentgen examination performed. It disclosed a large diverticulum communicating directly with the pharynx, and a smaller daughter diverticulum communicating with the larger diverticulum but not with the esophagus. The larger diverticulum had the classical appearance of a Zenker's diverticulum. The author excludes pulsion and traction as etiological factors in the production of these diverticula, and concludes that the diverticulosis is congenital in origin.

The second case is that of esophageal diverticulosis associated with diverticulosis of the small intestine. The esophageal diverticulum was fairly large, not productive of symptoms, and seen at the level of D5. This diverticulum is unremarkable except for the fact that it is probably a true pulsion diverticulum which is rare. Congenital origin cannot be excluded.

The third case is that of a three year old male with feeding difficulty since birth. A localized stricture in the distal esophagus was shown by roentgen examination. Endoscopically this constriction was seen to be associated with a membranous diaphragm with a centrally placed minute perforation. The diaphragm was disrupted and the stenosis dilated with good result.

The fourth case is that of a twenty-four year old male who had been accustomed to taking small feedings all of his life. Plain films showed a large shadow continuous with the mediastinum in the right upper chest. Occasionally a fluid level was seen. Fluoroscopy showed an elongated, tortuous, dilated, highly mobile esophagus. The esophagus coiled on itself. No diverticulum was demonstrated. The esophageal anomaly was associated with malrotation of the colon.

Ten roentgenograms are presented.—*W. H. Granger, M.D.*

Harrington, Stuart W. The surgical treatment of pulsion diverticula of the thoracic esophagus. *Ann. Surg.*, May, 1949, *129*, 606–618.

The author reports an interesting series of 8 cases of pulsion diverticula of the thoracic esophagus treated surgically. The pulsion diverticula are essentially herniations of the mucous membrane through the muscle layers and usually occur through the right posterior wall of the distal third of the esophagus. The other type of diverticulum, the traction diverticulum, is generally seen at the level of the bifurcation of the trachea and is caused by fibrosis of infected lymph nodes which have become adherent to the esophageal wall. These rarely produce symptoms. The symptoms of pulsion diverticula include progressive dysphagia, choking attacks, regurgitation or vomiting of recently ingested food. If a diverticulum reaches large size, it may cause obstruction and resultant marked weight loss.

Roentgenographic examination establishes the diagnosis. In 6 of these cases an associated small esophageal hiatal hernia was found. The author points out that it is essential to know the exact location of the diverticulum and if it contains food or foreign bodies.

A brief report of each case is included with surgical technique involved. One patient died postoperatively of pneumonia and mediastinal abscess.—*T. D. Allison, M.D.*

Effler, D. B., Blades, Brian, and Marks, Edward. The problem of the solitary lung tumors. *Surgery*, Dec., 1948, *24*, 917–928.

The authors consider the problem of management of asymptomatic solitary intrathoracic lesions which have been discovered through the present extensive use of roentgenographic examination of the chest. It is apparent that the incidence of this type of diagnostic problem will not decrease. Not only are periodic roentgenologic observations inconclusive but the ultimate fate of most patients is unknown. Exploratory thoracotomy is advised because with present operative and anesthetic techniques the mortality rate of such a procedure is less than 1 per cent.

This report concerns 24 cases of solitary asymptomatic intrathoracic lesions which were discovered by the routine roentgenographic examination of the chest. All data were reviewed at the Tumor Board Conference of Walter Reed General Hospital. Although there was no unanimity of opinion as to specific diagnoses, all lesions were thought to be benign. The preoperative and postoperative diagnoses together with the operative procedures used are summarized in a table, and there are abstracts of 10 representative cases. It is emphasized that these types of lesions should be investigated by surgical exploration because 15 per cent of those in this series proved to be malignant. There was no operative mortality or morbidity.

There were 4 malignant tumors and 7 tuberculomas in this series. Experience shows that tuberculomas are benign only in the sense that they do not undergo malignant change. They should be removed because of the danger of subsequent breakdown with dissemination of tubercle bacilli. This series of patients was composed of young adults for the most part. Such lesions in patients more than fifty years of age probably would show a higher incidence of malignancy.

It is concluded that because more asymptomatic lesions of the chest will be discovered and because prolonged observation is inconclusive, exploratory thoracotomy, which is an accepted procedure in all age groups, is advisable.—*C. B. Holman, M.D.*

Farber, Seymour M., Benioff, Mortimer A., and McGrath, Allen K., Jr. Diagnosis of bronchogenic carcinoma by cytologic methods. *Radiology*, April, 1949, *52*, 511–518.

The authors have been able to establish the diagnosis of malignancy in many instances in cases of pulmonary disease by finding and identifying exfoliated neoplastic cells in the sputum and bronchial aspirations. The malignant cells appear crowded in aggregations and are usually large with pleomorphic large irregular nuclei. Cornified cytoplasm and pearl formation may be evident in the epidermoid lesion. Adenocarcinoma cells may show huge vacuoles. The nonmalignant components of the sputum and bronchial secretions include: squamous epithelial cells, columnar cells, blood cells, histiocytes, macrophages, and metaplastic cells of the respiratory tract which must be differentiated from malignant cells.

The authors present six cases with equivocal findings in which cytologic studies established the diagnosis of malignancy. They emphasize the importance of examining a complete series of five sputum specimens before reaching an opinion. It should be realized also that the technic has definite limitations.—*J. N. Ané, M.D.*

Goldman, Alfred. The malignant nature of bronchial adenoma. *J. Thoracic Surg.*, April, 1949, *18*, 137–148.

Five cases showing malignant quantities in bronchial adenomas are reported. The most malignant changes to occur were found in the mixed tumor type of bronchial adenomas. The complete transformation to a clinical and histopathologic picture of bronchiogenic carcinoma has been observed and is reported. It is suggested that carcinoma of bronchiogenic origin may, at times, arise in a mixed tumor type of bronchial adenoma. Carcinoid types of bronchial adenoma not infrequently show metastatic involvement of the mediastinal lymph nodes. This may occur when the tumors have been present for as long as thirty years or when the duration of symptoms is only a few months. The failure of bronchial adenoma to produce vascular seedings even though the tumor cells were demonstrated floating in the lumen of a large pulmonary vein suggests that the only favorable soil for bronchial adenoma is in the bronchi and lungs. The treatment is discussed. The malignant nature of bronchial adenoma is not so malignant nor is its benign course so benign.—*Frederick Reis, M.D.*

Rabin, Coleman B., and Neuhof, Harold. Adenoma of the bronchus. *J. Thoracic Surg.*, April, 1949, *18*, 149–163.

The literature and microscopic picture of bronchial adenoma are discussed and the

authors' experience with 64 cases is reported. The microscopic characteristics are those of a benign neoplasm, with an orderly arrangement of distinctive cells and a virtual absence of mitotic figures. Metastasis is not common and when present consists usually of limited involvement of an adjacent lymph node, in which the pattern of the parent tumor is repeated. Remote metastases are extremely rare and consist usually of minute deposits which repeat the pattern of the primary tumor. Bronchial adenoma occurs in the larger bronchi in the greater majority of cases, rarely in bronchi which are too small to be accessible to the bronchoscope. The tumor may be situated superficially within the bronchus or extend through the wall to a varying degree. Complete eradication of a superficial tumor can be achieved by endoscopic treatment, particularly when the tumor is situated in a main bronchus. Not only cure but also subsidence of infection and retention of the lung can be achieved thereby. In the case of extension into or beyond the bronchial wall, local excision by bronchotomy can be considered. The contraindications to bronchoscopic treatment are outlined. The indications for lobectomy or pneumonectomy are stated.

The treatment of bronchial adenoma should be based on the concept of a benign neoplasm with a long history and not on the concept of a cancerous or precancerous lesion.—*Frederick Reis, M.D.*

Budd, John W. Evaluation of needle aspiration technic in breast lesions. *Radiology*, April, 1949, *52*, 502–505.

The author stresses the plea for histopathological diagnosis of every lump occurring in the breast. The discussion is confined to the method of obtaining the necessary cells for diagnosis by needle aspiration of fluid of cystic lesions, needling solid tumors while applying suction and obtaining the necessary cells, and the removal of a solid core by aspiration adequate for paraffin sections.

Needle biopsy is easily obtained with a minimum amount of trauma in the inoperable group who are treated with irradiation. Operable breast cancer should be diagnosed by frozen section biopsy prior to surgery. There is no indication for use of needle biopsy in this group. Breast cysts should probably not be diagnosed or aspirated by needle biopsy, surgical excision is the treatment of choice, and not needle biopsy.

In summary, it appears that the author really condemns needle biopsy in all of the breast lesions except in the obvious inoperable carcinomas and then is used mainly to confirm diagnosis before irradiation.—*E. A. Addington, M.D.*

Clemmesen, J. Carcinoma of the breast; results from statistical research. *Brit. J. Radiol.*, Dec., 1948, *21*, 583–590.

The author presents a discussion of statistics on breast cancer derived from the Cancer Registery of Denmark for the years 1942–1944. Arguments are presented first for the unreliability of the usual type of cancer mortality statistics, and then the volunteer system of cancer reporting in Denmark is described in detail. Several interesting conclusions can be drawn from the accumulated results of the first three years of the survey: (1) There is a fall in incidence of breast cancer between the ages of forty-five and fifty-five years, due perhaps to climacteric influences. (2) A definitely increased incidence of carcinoma of the breast in unmarried, widowed or divorced women as compared to married women is shown. The opposite situation prevails in respect to carcinoma of the cervix uteri. (3) In addition to a considerably higher frequency of *breast* carcinoma among the relatives of cancer patients than among those of controls, there is a higher incidence also of *all* types of cancers. There is a tendency for several members of the same family to inherit breast cancer with localization to the same breast (*i.e.*, the same side, right or left). (4) There is a surplus of both reported injuries and cancer of the left breast, but it is impossible to decide if there is any causal connection between these two phenomena.—*Harold Fulton, M.D.*

Kemp, F. H., Morley, H. M. C., and Emrys-Roberts, E. A sail-like triangular projection from the mediastinum; a radiographic appearance of the thymus gland. *Brit. J. Radiol.*, Dec., 1948, *21*, 618–624.

Of a consecutive series of 498 young children, 44 (8.8 per cent) demonstrated roentgenographically a sail-like triangular projection from the mediastinum. More frequently in this series the usual type of globular or ovoid type of thymic enlargement was encountered. In all cases chest films were taken first at the age of six months and subsequently at six month intervals. There were 12 children with large shadows of this triangular type, 12 with

medium-sized shadows and 20 with small shadows. In 31 cases the shadow was on the right side, in 12 on the left and in 1 there were small bilateral projections. Lateral films proved unsatisfactory in identifiying these shadows. Postmortem examinations on 3 cases proved quite convincingly that the structure concerned is the thymus. Whether this type of thymic shadow represents enlargement of the thymus gland is questioned. In none of the present cases were there any local or systemic manifestations of thymic hyperplasia nor was enlargement of the pharyngeal lymphatic tissues encountered more frequently than in a control series. Appropriate roentgenograms illustrate the structure described in various ages and phases of the respiratory cycle.—*Harold Fulton, M.D.*

Mac Rae, D. J. Spontaneous pneumomediastinum in pregnancy. *Lancet*, May 28, 1949, *1*, 902–904.

This is a report of 2 more cases of spontaneous pneumomediastinum occurring during labor and apparently due to the strain of labor. A previous case was reported by Rigler in 1925. In each case, the labor was apparently normal and the rupture occurred when the patient was bearing down with great force during the labor.

Air in the mediastinum may be unsuspected and may be discovered only on roentgenography of the chest, or its presence may be suggested by emphysema of the subcutaneous tissues of the thorax or neck. The differential diagnosis is chiefly from pneumopericardium. The distinguishing feature is that in pneumomediastinum the air extends above the level of the pericardial sac. The absence of untoward symptoms, the presence of air in the subcutaneous tissues of the neck, and its early absorption, point to a pneumomediastinum.—*J. S. Summers, M.D.*

Grossman, J. W., and Cramer, O. S. Mediastinal emphysema occurring during an acute paroxysm of bronchial asthma. *Radiology*, May, 1949, *52*, 705–706.

The authors report the incidence of, and Macklin and Macklin's theory for, the production of mediastinal emphysema. Certain features concerning this complication of bronchial asthma are enumerated. The roentgen findings of this condition are described as air in the subcutaneous tissue of the neck and chest, and air in the mediastinum. The latter finding may be seen either on the posteroanterior or lateral view. There is one case report.—*G. J. Culver, M.D.*

Fridjohn, L., and Azzopardi, P. J. Acute mediastinal and subcutaneous emphysema. *Lancet*, May 28, 1949, *1*, 904–905.

This is a report of a case of acute mediastinal and subcutaneous emphysema occurring in a patient due to a status asthmaticus in pregnancy. The patient was twenty-nine years of age. She was a primipara of eight months pregnancy, but not in labor. The status asthmaticus was controlled by injections of adrenalin. The patient was kept in an oxygen tent. She was symptom free after the third day and delivered a stillborn child on the eighth day. The article includes reproductions of roentgenograms showing emphysema of the mediastinum and of the left forearm.—*J. S. Summers, M.D.*

Humphrey, A. A., and Olmstead, E. G. Lipoid pneumonia in neuropsychiatric and debilitated patients. *Dis. of Chest*, April, 1949, *15*, 471–479.

Four case histories of lipoid pneumonia are presented from a series of 73 consecutive autopsies performed at the Veterans Hospital, Fort Custer, Michigan. The high frequency is due to the difficulty in feeding and medicating patients of severe neuropsychiatric disorders where aspiration is a constant hazard. The most common cause of lipoid pneumonia is the use of mineral oil, cod-liver oil or oil-agar preparations in daily large amounts. This results in cough, and repeated pulmonic infections. Expectoration of oil in the sputum, while on a fat-free diet, is of diagnostic importance.

The roentgenological findings appear as an early increase in the bronchial markings, usually on the right, suggesting bronchiectasis. The lung periphery is not involved, but the shadows become confluent and nodular with an irregular border which later suggests malignancy. The hila may not be involved, or a smooth large oval mass of paraffinoma may be hilar in location. Persistence of the lesion is the most important single factor, although intercurrent infection may alter the roentgen appearance. In addition, the patient may be asymptomatic, and the oil stopped, yet the lesion shows progression on the roentgenograms.

Pathologically lipoid pneumonia could better be termed "pneumolipoidosis," since the lipoid reaction acts only as a predisposing factor to secondary infection and pneumonitis. The oil droplets are absorbed by macrophages which fill the alveoli, producing a foamy appearance. Fibrosis may result in longstanding cases.

The treatment is entirely prophylactic with contraindication of oil medications in debilitated patients or those with bulbar involvement.—*Frederick R. Gilmore, M.D.*

Snell, V. Tomography in surgical tuberculosis. *Proc. Roy. Soc. Med.*, London, Dec., 1948, *41*, 853–856.

This paper contains the conclusions reached as a result of tomographic investigation of a number of cases with combined pulmonary and surgical tuberculosis.

Tomography is judged to be of considerable value in assessing bone destruction and the number of vertebrae involved in tuberculosis of the spine. This applies particularly to the lower cervical and upper dorsal vertebrae, and also to the lower dorsal vertebrae where the structures of the shoulder and diaphragm make plain roentgenograms difficult to interpret. Tomography is of value throughout the dorsal spine in the presence of pulmonary disease. In these cases it is often uncertain whether the markings on the roentgenograms are in the bone or in the overlying lung tissue.

Tomography is of little value in other regions of the spine, and it offers little advantage over plain roentgenograms of other bones and joints. Nine roentgenograms are reproduced.—*D. R. Bernhardt, M.D.*

Meade, Gordon M. The prevention of primary tuberculous infections in medical students; the autopsy as a source of primary infection. *Am. Rev. Tuberc.*, Dec., 1948, *58*, 675–683.

In an attempt to decrease the incidence of tuberculous infection in medical students, the University of Rochester School of Medicine and Dentistry made a study to determine the sources of infection. In that particular medical school, the chief source was found to be the autopsy. Included is a brief summary of the experience of other schools in finding a higher incidence of tuberculous infection in students of medicine than in other branches, and in demonstrating the contamination of air and laboratory equipment during examination of tuberculous lungs.

In accordance with this knowledge, all participation in tuberculosis autopsies and handling of tuberculous tissues by second year medical students was eliminated, with a resultant marked reduction in the number of primary infections during the second year. Six classes observed prior to this policy (and participating in tuberculosis autopsies) showed 5.42 per cent positive reactors at the end of the first year, and 92 per cent positive reactors by the end of the second year. Following the change of policy four classes showed 36.4 per cent positive reactors at the end of the first year, and 38.8 per cent at the end of the second year.—*Lois Cowan Collins, M.D.*

Bobrowitz, I. D., and Hurst, Allan. Minimal tuberculosis; problems in roentgen interpretation. *Radiology*, April, 1949, *52*, 519–532.

Because of the common practice of classifying minimal tuberculous lesions on a clinicopathologic basis by roentgen methods, it is extremely important to realize the limitations and the discrepancies of this procedure. The terms employed are: exudative, exudative-productive, productive-fibrotic and fibrocalcific. Considerable difference of opinion exists in film interpretation and it is extremely difficult and sometimes impossible to obtain an accurate classification on a single roentgenogram. More accurate information is possible when serial films of the lesion are available.

The authors studied the clinical significance and prognosis of minimal tuberculosis in a group of 220 sanatorium cases. It was important to have a lesion completely and clearly visualized before any attempt at classification of the process as a minimal lesion was considered. Apical, oblique, lateral and stereoscopic views and laminagrams were employed when indicated. There are many reproductions of cases illustrating the value of these special views.—*J. N. Ané, M.D.*

Cincotti, John J., Allison, Stanton T., and Nilsson, John M. Pleural effusion simulating elevated diaphragm. *Am. Rev. Tuberc.*, Nov., 1948, *58*, 554–561.

An atypical distribution of pleural fluid sometimes simulates an elevated diaphragm. A case of this type is reported. The correct diagnosis was made by means of a film taken in ex-

piration, on which the fluid assumed the position commonly seen in pleural effusion. On the inspiration film, however, the fluid was distributed over the diaphragm so as to simulate elevation of the diaphragm.

Reference is made to the six cases observed by Rigler, in which he advocated prone or supine films for diagnosis, the 3 similar cases described by Parsonnet, Klosk and Bernstein, and 1 case reported by Yater and Rodis.—*Lois Cowan Collins, M.D.*

Stauffer, Herbert M., and Jorgens, Joseph. Electrokymography of the heart and great vessels; correlation with roentgenkymography in clinical case studies. *Radiology*, April, 1949, *52*, 488–501.

By the use of an electron-multiplier phototube the authors have been able to translate the changes in roentgen-ray intensity produced by pulsating vascular structures in the chest into recordable variations of electrical potential. The electrokymograph has an advantage over multiple slit roentgen kymography in that accurate timing with carotid pulse and or heart sounds is readily feasible; this facilitates identification of a particular type of motion with a definite roentgenologic analysis of cardiovascular pulsations on a sound physiological basis. The study is based on 20 normal young adults and a small group of abnormal cases representing a variety of cardiovascular conditions.

The apparatus used and technique are discussed in detail. A complete discussion of the normal recordings together with the correlation with the roentgen kymograms and recorded heart sounds is included. The authors point out the difficulty in evaluating the changes that are recorded as to whether or not they are due to volume or positional changes. The roentgen kymograph has apparent advantages over the electrokymograph in certain respects. It is pointed out that the electrokymograph should be regarded as a useful refinement to use in conjunction with the roentgen kymograph.—*E. A. Addington, M.D.*

Meyer, Ralph R. Heart measurement, a simplified method. *Radiology*, May, 1949, *52*, 691–700.

In order to simplify heart measurements without loss of accuracy, it becomes desirable (1) to obtain an average divergent distortion factor, (2) to use only those borders which can be seen on a chest film, and (3) to combine in one nomogram the equation for predicting normal size with the equation for measured size in such a way that percentage variation from normal could be read directly.

Using a 72 inch target film distance, the greatest possible deviation from the average is about 2 per cent of the total frontal plane area, despite the fact that the anteroposterior chest diameters varied from 16.5 to 29 cm.

The product of the long and short diameters multiplied by a correction factor for divergence will give a reasonable approximation of frontal plane area.

In order to avoid drawing the empiric upper and lower heart borders, the long diameter is measured from the junction of the right heart border and the great vessels to the cardiac apex, and the short diameter from the junction of the left heart border and pulmonary conus to the right cardiophrenic angle. These diameters are approximately perpendicular to each other, but need not be.

A nomogram and directions for its use are illustrated. The subject should be an adult seventeen years old or older, or younger only if over 170 cm. tall, and the examination must be a 6 foot posteroanterior examination.—*Benjamin Copleman, M.D.*

Parkinson, John. The radiology of rheumatic heart disease. *Lancet*, May 28, 1949, *1*, 895–902.

This is the Carey Coombs Memorial Lecture delivered at the University of Bristol, on January 22, 1949. It is an excellent review of the roentgenographic signs of rheumatic heart disease. It is well illustrated. It is worthy of close study by those interested in rheumatic heart. However, it presents no new material that should be reviewed here.—*J. S. Summers, M.D.*

ABDOMEN

Tallant, Edward J., O'Neill, Hugh A., Urbach, Frederick, and Price, Alison H. Gastro-intestinal food hypersensitivity; roentgenographic demonstration. *Am. J. Digest. Dis.*, April, 1949, *16*, 140–150.

A survey of the pertinent literature leads the authors to believe that the small bowel is intimately involved in the production of symptoms in gastrointestinal food hypersensitivity. A roentgenographic approach is described,

whereby changes in the small intestine in sensitive and non-sensitive patients may be evaluated under controlled conditions. In a group of 12 patients with clinical gastrointestinal food hypersensitivity, roentgenographic abnormalities of the small intestine, consisting of narrowing, segmentation and scattering, were found following the feeding of a specific barium-allergin mixture. The absence of similar significant changes in the barium-water control studies, made on the same patients, and in both the barium-water and barium-food series in non-sensitive patients indicates the importance of these findings.

Abnormalities of the small intestine could not be demonstrated in food hypersensitive patients whose allergic disturbances were not manifested in the gastrointestinal tract. It must be emphasized that the changes described in the small bowel are, in themselves, nonspecific and acquire diagnostic significance only when a comparable study without the allergin, made on the same patient after a sufficient long elimination of the suspected food, is normal.—*Franz J. Lust, M.D.*

Cave, P. The use of CO_2 and air as antispasmodics. *Brit. J. Radiol.*, April, 1949, *22*, 216–223.

In gastrointestinal roentgenology, narrowing of an alimentary tract lumen is a common finding and it is essential to determine its cause. Spasm of the gut occurs, either alone or in combination with organic lesions, and elimination of it as a factor in narrowing is important. The author has found that inflation of the esophagus, stomach and colon by various means causes temporary abolition of spasm and allows proper evaluation.

With achalasia of the cardia, inflation can empty the esophagus as effectively as the nitrates with none of the latter's distressing side effects. The author recommends that after noting delay of passage of barium through the cardia, the patient be placed in the upright position and the lower third of the esophagus be filled with barium mixture. A Seidlitz powder in a small amount of water is quickly gulped by the patient as it is effervescing. Roentgenoscopically a dramatic relaxation of the cardia is observed. Early carcinoma at any level in the esophagus can be delimited from localized areas of spasm by this method, and in advanced cases of malignancy the increased tension produced by the carbon dioxide above the lesion may cause some barium to trickle through the stenotic area and reveal its length—often an important surgical consideration. Ulcerative esophagitis, fibrosis and constricting esophageal bands may also be thus studied.

Inflation of the pyloric end of the stomach with a mixture of barium solution and Seidlitz powder will aid in the differentiation of antral carcinoma and pyloric spasm secondary to chronic pyloric or duodenal ulcer. After ingestion of the mixture, the patient is rotated to the left side, while lying, and then to the left oblique supine position to show the antrum and duodenal bulb outlined by gas. The cap is filled with barium by then rolling the patient into the prone position. Finally the patient is rotated again to his left side and then onto his back and a double contrast of the distal portion of the stomach results. The entire procedure is done rapidly to avoid excessive mixing of the medium.

Prepyloric spasm and spasm of the pars media may cause suspicion of carcinomatous infiltration of the gastric wall; inflation will show a flexible wall in benign conditions and rigidity accompanying malignant involvement. Hypertrophic gastritis may produce a leather bottle type of stomach but this too will distend.

The mucosal pattern of the colon is usually studied by air injection and air-contrast enemas, but alterations in luminal size would also be investigated by air insufflation. Again the differentiation of spasm and organic narrowing may be possible.

It is concluded that inflation to overcome spasm and to determine distensibility of certain parts of the alimentary tract is a simple diagnostic method with wide possibilities. The method is dependable and without danger in the author's experience. Roentgenograms illustrate selected cases.—*Harold Fulton, M.D.*

Lobsenz, H., and Jauernig, R. R. The retrogastric space, roentgenographically considered. *Radiology*, May, 1949, *52*, 701–704.

The purpose of this paper was to evaluate the importance of distance alone, from the posterior stomach border to the anterior border of the adjacent vertebral bodies, in the diagnosis of retrogastric masses. The left lateral erect exposure was used in 97 patients with complaints indicative of intrinsic gastrointestinal disease.

The authors conclude that the diagnosis of

retrogastric masses depends upon the actual demonstration of extrinsic pressure defects in the posterior gastric wall. A distended splenic flexure may cause such a defect, and this must be differentiated from pathological lesions. The measurements of the distance from the posterior border of the stomach to the anterior border of the vertebrae is of no value in the diagnosis of retrogastric tumors.—*G. J. Culver, M.D.*

Strang, C., and Warrick, C. K. Radiological demonstration of ascaris infestation. *Brit. J. Radiol.*, Nov., 1948, *21*, 575–578.

Roentgenoscopic and roentgenographic methods of diagnosis in the detection of *Ascaris* intestinal infestation are stressed. These are of value, particularly where the presence of worms is overlooked clinically, in rare instances where only male worms are present (producing no ova), and where immature female worms incapable of producing ova are present. The worms are demonstrated by band-shaped filling defects by barium adhering to the surface of the parasite or due to its presence in the enteric canal of the parasite. Irritability and disordered motility of the bowel may be observed. Serial roentgenograms of the abdomen are taken at half hour intervals after the ingestion of the barium meal. Their presence is usually incidentally observed in the course of an examination for peptic ulcer, carcinoma, or gallbladder dysfunction.

A case is reported illustrating certain of the above features.—*K. L. Krabbenhoft, M.D.*

Samuel, E. The radiological diagnosis of chronic amoebic colitis. *Brit. J. Radiol.*, Dec., 1948, *21*, 625–631.

By means of barium enema and occasionally the barium meal, the author has investigated cases of amebic colitis in all phases of the disease. In the acute stage there are no characteristic findings in the colon; in the chronic phase, however, there are several diagnostic roentgen features. (1) The normal sac-like appearance of the cecum is replaced by a gradual narrowing of the cecal walls until the cecum assumes the appearance of a cone. The cecal wall becomes shaggy and irregular. Other portions of the colon, especially the ascending and transverse, show localized narrowing plus the shaggy outline of the wall. (2) Persistent spasm of any localized segment may occur; if in the left half of the colon it may be secondary to many other factors and does not have the same significance as regards and amebic etiology as such manifestations occurring in the right half of the colon. The entire colon often exhibits a marked irritability and evacuation after the barium enema is abnormally complete. (3) The earliest lesions are in the mucosa and in the acute phase of the infection the mucosal folds are heaped up into more prominent folds than normal and in addition assume a more complex pattern (the "confused type"). Examination during the chronic period reveals that the mucosal pattern is flattened and replaced by a smooth or granular appearance which is secondary to the fibrosis of the colonic wall. (4) The type of lesion most rarely seen is the ameboma. This is a granulomatous tumefaction containing numerous amebae and cystic forms. This occurs most frequently in the cecal area and resembles a carcinoma but the colonic wall usually fades into the ameboma in contrast to the abrupt change characteristic of malignancies. A therapeutic test does will often cause the ameboma or amebomas to shrink or disappear. (5) In late cases a "pipestem colon" as typically seen in ulcerative colitis may be present.—*Harold Fulton, M.D.*

McGraw, J. P., Kremen, A. J., and Rigler, L. G. Roentgen diagnosis of volvulus of the cecum. *Surgery*, Nov., 1948, *24*, 793–804.

The authors present criteria whereby volvulus of the cecum or of the right half of the colon may be recognized roentgenologically. A survey of the literature indicates this lesion to be a causative factor in approximately 1 per cent of all cases of intestinal obstruction. The axis of rotation may be transverse, oblique or parallel to the long axis of the cecum and ascending colon and 180 degrees of torsion is usually considered sufficient to produce obstruction.

Anatomic causes of volvulus of the cecum include abnormal mobility of the cecum which is present in 10 to 15 per cent of adults, a long mesocecum and mesocolon, common ileocecal mesentery, retroperitoneal ileum and malposition of the cecum. Functional causes mentioned are stasis and hyperperistalsis as well as a high residue diet, violent exercise, pregnancy and tumors. It may follow abdominal operation.

The authors have presented clinical data and roentgenograms in 4 cases which illustrate many of the following roentgenologic criteria: (1) a dilated cecum in an abnormal location;

(2) loops of small intestine lying to the right of the distended cecum; (3) the ileocecal valve lying to the right of the distended cecum; (4) a cone-shaped obstruction of the ascending colon with spiral mucosal folds which are sometimes evident on the plain roentgenogram but may be absolutely diagnostic when demonstrated after a barium enema; (5) usually only a single fluid level in the colon when films are made with the patient in the upright position.

Volvulus of the sigmoid, adynamic ileus and organic obstruction of the transverse or left colon should be considered in the differential diagnosis. The treatment is operative. Cecostomy, however is followed almost uniformly by fatal outcome.—*C. B. Holman, M.D.*

Burt, Con Amore V. Carcinoma of the cecum complicated by appendicitis or para-cecal abscess. *Surg., Gynec. & Obst.*, April, 1949, *88*, 501–508.

The preoperative diagnosis of acute appendicitis and periappendicitis in association with carcinoma of the cecum is extremely difficult and is rarely made. Too frequently it has not been made at the first operation, and, therefore the indicated radical surgery has been unduly delayed.

1. Barium enema should be done in cases suspected of harboring a carcinoma of the cecum. However, too much dependence cannot be placed on the interpretation as small filling defects can be easily overlooked or the findings misinterpreted.

2. The persistence of a fecal fistula for more than six to eight weeks following an operation for pathology in the cecal area should make the surgeon acutely conscious of the possibility of an underlying cancer of the cecum and should indicate further operative intervention.

3. Every effort should be made to explore adequately the entire cecal area to determine whether a carcinomatous lesion is present.

4. The presence of pus or abscess cavity in the vicinity of the cecum should not be a deterrent to satisfactory exploration. The patient has already developed considerable natural immunity as the result of the abscess formation.

5. Adequate biopsy should be taken if the surgeon cannot, within reasonable limits, make a clinical diagnosis of cancer.

6. A cecotomy should be done for palpation of the inner surface of the cecum where there is doubt about the diagnosis.

7. Early and radical operation is the only hope of cure in these cases of carcinoma of the cecum with acute appendicitis.—*Mary Frances Vastine, M.D.*

Price, Alison, Urbach, Frederick, O'Neill, Hugh A., and Tallant, Edward J. Propeptan therapy for gastro-intestinal food hypersensitivity. *Am. J. Digest Dis.*, May, 1949, *16*, 161–171.

The results obtained in the treatment of 10 patients suffering from gastrointestinal food hypersensitivity, using type-specific food digests (propeptans) are described. Excellent results in clinical improvement occurred in 7 of the 10 patients. The 3 patients who obtained only temporary clinical improvement had severe psychiatric disturbances.

Roentgenographic abnormalities of the gastrointestinal tract, present before the institution of the treatment, completely or almost completely disappeared in all patients following the completion of the treatment. The method of treatment, the possible mechanism of action and the sources of error are discussed. The promising results of this small series warrants further study and treatment of other patients who have gatrosintestinal sensitivity to food.—*Franz J. Lust, M.D.*

Epstein, Bernard S., and Friedman, Robert L. Arteriosclerotic aneurysm of the descending thoracic aorta presenting to the right of the spine. *Radiology*, July, 1949, *53*, 93–96.

A case is reported of an aneurysm of the descending thoracic aorta with a tabulated review of literature on the location of aortic aneurysms. This case presented to the right of the spine simulating a mediastinal metastasis from a bronchogenic carcinoma. The patient had frothy hemoptyses and negative serological findings.—*C. H. Warfield, M.D.*

Lavarde, Jean, and Chevret, Robert. Contribution a l'étude radiologique des occlusions. Hernie étranglée de l'hiatus de Winslow. (Contribution to the roentgen study of occlusions; strangulated hernia in the foramen of Winslow.) *Presse méd.*, June 15, 1949, *39*, 562–563.

Three roentgenograms are shown from a case of strangulated hernia in the foramen of Winslow—a distal loop of ileum passing upward

across the transverse colon, into the foramen and out again, the now erect ileocecal area being at the right transverse colon. An upright preliminary film of the abdomen showed typical small bowel obstruction pattern with fluid levels located especially in the left abdomen.

The authors call attention to this roentgen sign: barium enema reveals a stoppage at the mid-transverse colon which does not have the appearance of a new growth, but either appears as a spiral defect or as a linear compression across the transverse colon.

There are four excellent line-drawings of this type of hernia from cases in the very few articles on this subject in the German and American literature; and the authors' case is diagrammed.—*William M. Loehr, M.D.*

Pickhardt, Otto C., Rafsky, Henry A., and Ghiselin, Francis H. Treatment of hiatus hernia in older persons. *J.A.M.A.*, Feb. 4, 1950, *142*, 310–315.

Esophageal hiatus hernia may exist without symptoms or may simulate disease in other organ systems as cholelithiasis or cardiovascular disease. In this report, which is based on 29 patients ranging in age from fifty to eighty-six years, epigastric and chest pain, gastric distress, vomiting with or without hematemesis, melena and dysphagia were complained of. The esophageal hiatus hernia was demonstrated roentgenographically in 7 males and 22 females. The presenting syndromes were grouped as acute gastrointestinal obstruction; early gastrointestinal obstruction; acute constriction of the stomach with gastric hemorrhage; chronic anemia; hematemesis; peptic ulcer, etc. Studies of other systems were made as indicated and among the patients in the series were found ulcers in 9, chronic anemia 13, cardiovascular disease 10, obstructions 5. The patients often had more than one symptom or associated disease.

Roentgen estimation of the amount of stomach herniation varied from less than 10 cm. in 11 patients, between 10 cm. and one-half of the stomach in 11, and from one-half of the stomach to complete herniation of the stomach in 7 patients.

Treatment was medical for relief of symptoms due to herniation and associated diseases until it failed to give adequate relief and then surgery was employed. The most satisfactory surgical approach was the interruption of the phrenic nerve by simple phrenic crushing, partial excision or exeresis. Simple crushing was preferred for the first procedure because it frequently gave permanent paralysis of the left hemidiaphragm with relief of symptoms. It is a mild procedure and not accompanied or followed by shock and the only and infrequent complication was moderate atelectasis of the lower left lung which cleared spontaneously. The complications of exeresis are shock, hemorrhage, mediastinal infection, hematoma, and pneumothorax. When symptoms recurred after the initial phrenic crushing, either a second crushing or partial exeresis was usually carried out (exeresis was performed only twice).

Results of the original operation: unimproved 1, improved but with residual symptoms 15, improvement lasting five to eight years 9 (but requiring additional later operations in 6), decided improvement over varying periods of time from six months to nine years in 13. It is pointed out that the incidence of hiatus hernia varies from 5 to 10 per cent in the older age groups, but many are asymptomatic and only those whose symptoms cannot be controlled medically are subjected to the phrenic surgical procedure. After the operation, in addition to the high paralyzed diaphragm, definite relaxation of the esophageal opening and immediate loss of spasm and partial slipping down of the herniated portion of the stomach were observed.—*R. K. Arbuckle, M.D.*

MacCarthy, H. Acute volvulus. *Irish J.M.Sc.*, Feb., 1950, *6*, 88–93.

The author discusses the following anatomical types of volvulus:

1. Volvulus of the stomach.
2. Volvulus of the gallbladder.
3. Volvulus of the small intestine.
4. Volvulus of the cecum.
5. Volvulus of the sigmoid colon.

The author does not give any figures as to frequency of occurrence, but he does point out that in practically all cases of volvulus there is some mild developmental deformity present, such as an extremely long mesentery to the particular portion of the gastrointestinal tract under discussion. If the mesentery is not sufficiently long, a volvulus cannot occur because of the lack of mobility of the organ.

Most of his cases also are associated with pathology, such as gastric carcinoma or ulcer, cholelithiasis, Meckel's diverticulum, preg-

nancy, or constipation. This pre-existing pathology is thought to be necessary to permit the twisted organ to have an axis about which the rotation may occur. The axis may consist of adhesions, blood vessels, or peritoneal ligamentous attachments.

Distention of the viscus, whether with gas or solid material, is common, and the weight of the organ helps to produce the twist. The weight of a tumor along the ante-mesenteric border of the organ may have a similar effect. Trauma, as described in his volvulus of the cecum, may excite the twist in the same way as vigorous peristaltic or anti-peristaltic waves. —*E. L. Pirkey, M.D.*

Dailey, Morris E. Gastroscopy in the evaluation of patients with peptic ulcer. *Radiology*, June, 1949, *52*, 796–799.

The object of this paper is to discuss the value and limitations of gastroscopy as a diagnostic aid and as a guide to the efficacy of therapy in patients with duodenal, gastric, and stomal ulcers.

A brief description of procedure in gastroscopic study and anatomic variations is given.

Contraindications to gastroscopy are set forth.

The author states that gastroscopy and roentgenography of the stomach are methods which nicely complement each other, the former enabling one to see large areas of mucosa in detail, the latter to discover abnormalities of contour, pliability, or peristalsis, and to identify lesions in areas inaccessible to the gastroscope. Only on rare occasions is gastroscopy performed prior to barium examination and it is the radiologist who informs the gastroscopist as to the site of various lesions and where the major portion of the examining time should be spent.

Gastroscopic findings in duodenal ulcer, gastric ulcer and stomal ulcers and postoperative gastritis are set forth with the following conclusions.

1. Gastroscopy is of diagnostic aid in ruling out associated gastric disease when duodenal ulcers are suspected of causing chronic bleeding or obstruction, or when response to therapy is poor.

2. Benign gastric ulcers may be rather accurately differentiated by gastroscopy from malignant ulcers, but proof of benignity of an individual gastric ulcer is establishment, by gastroscopic examination, of absolute healing.

3. Significant gastritis or jejunitis may be found gastroscopically in postoperative stomachs when no roentgen signs of disease are evident.—*John H. Gilmore, M.D.*

Olnick, H. M., and Weens, H. S. Roentgen manifestations of infantile hypertrophic pyloric stenosis. *J. Pediat.*, June, 1949, *34*, 720–729.

Earlier reports on hypertrophic pyloric stenosis emphasized the importance of gastric hyperperistalsis, dilatation and retention in the roentgen diagnosis. However, these changes are not specific and have been described in numerous other conditions. The more modern methods of roentgen diagnosis require the demonstration of a narrowed elongated pyloric canal, the so-called "string sign." A second sign is the so-called "pyloric beak," which is due to protrusion of barium from the distal part of the pyloric canal in the shape of a bird's beak. Finally, the pyloric tumor, by protruding into the lumen of the duodenal cap, causes an indentation of the base of the cap. These changes are all illustrated by the author by means of schematic diagrams and films.

The authors have found the examination of these infants with barium to be free from harmful results such as the production of a complete obstruction or aspiration pneumonia. Their technique, which includes preliminary aspiration of the stomach by a gavage tube, is presented.

In a series of 22 cases, 21 of which were proved by operation, the "string sign" was demonstrated in the 19 cases which were proved positive. The indentation of the base of the duodenal cap was demonstrated in 7 cases. Follow-up studies showed the persistence of the pyloric narrowing for years in spite of the absence of clinical symptoms. The authors suggest this as the possible cause of a narrowed pyloric canal when found in adults.—*Rolfe M. Harvey, M.D.*

Templeton, Frederic E. Peptic ulcer; the importance of films in diagnosis. *Radiology*, June, 1949, *52*, 777–780.

A good gastrointestinal examination requires both fluoroscopy and films. Properly made films frequently aid in the detection of small lesions of the order of 1 centimeter or less. Occasionally even a larger lesion is detected

which has been missed under the fluoroscope because of such factors as overwork, fatigue, or failure to follow a set routine. The author points out that films made under fluoroscopic control are usually most valuable and should include not only areas which look abnormal under fluoroscopic observation but also routine films of various sections of the tract.—*M. M. Friedman, M.D.*

WILBUR, DWIGHT L., and WATTS, MALCOLM S. M. Peptic ulcer; modern criteria for diagnosis and attempted diagnosis of healing. *Radiology*, June, 1949, *52*, 800–809.

The authors discuss the clinician's point of view in regard to the problem of the diagnosis or healing of peptic ulcer, based not only upon the subjective clinical data which the clinician obtains from the patient but also upon the interpretation of the objective information furnished by the radiologist.

Two hundred consecutive cases examined roentgenologically for a group of internists practicing in the same office were reviewed to determine how much attention the clinician practicing in internal medicine pays to the roentgen studies and why he had these studies made. The clinical indications were as follows: (1) "ulcer story," 41 cases; (2) dyspepsia, 54 cases; (3) vague abdominal symptoms, 70 cases; (4) reassurance to patient, 6 cases; (5) other causes, 29 cases.

The series is small and in only a few cases were findings confirmed by anatomic or pathologic study. A normal stomach was reported in half the cases. Roentgenologically, 8 cases of gastric ulcer were diagnosed but the clinician concurred in only 4 cases. There are 43 cases of duodenal ulcer with clinical concurrence in only 32 cases. In those cases with a final diagnosis of carcinoma of the stomach, the roentgen diagnosis was definite in only one case.

Closer cooperation is needed between the clinician and radiologist when there is a discrepancy in the findings and further studies should be carried out.—*Norman Heilburn, M.D.*

STEVENSON, C. A., and YATES, C. W. Accuracy of roentgen diagnosis of benign gastric ulcer. *Radiology*, May, 1949, *52*, 633–641.

Stevenson and Yates reviewed 117 consecutive cases in which the roentgenologist reported a benign gastric ulcer. Ninety-one cases had adequate follow-up or microscopic diagnosis.

Six cases proved to be malignant. On the basis of 91 cases adequately followed, the roentgenologic report of a benign gastric ulcer was 93.4 per cent correct.

On reviewing the roentgenograms and fluoroscopic findings, the authors were unable to find any difference in the 6 malignant cases. The procedure is about as accurate as any test in the field of medicine, but the authors believe it is impossible, at any one roentgenologic examination, to definitely differentiate a benign gastric ulcer from a gastric carcinoma.—*Arthur A. Brewer, M.D.*

BOLKER, NORMAN. Early diagnosis of carcinoma of the stomach. *Ann. Int. Med.*, May, 1949, *30*, 903–913.

Carcinoma of the stomach continues to be the foremost cause of cancer deaths. Despite improvements in diagnostic and surgical techniques, five year survival rates have not been altered appreciably in the past ten years, and there is no reason to believe that they will be in the future. The increased use of roentgen-ray and gastroscopic examination have led to more frequent diagnoses of gastric carcinoma but not to increased cures. All of our present diagnostic methods depend on the patient presenting himself because of symptoms. Due to the silent nature of the disease, the symptoms are rarely severe enough to bring the patient to the physician until the tumor has become widespread.

In an effort to discover any findings that might lead to earlier diagnosis, 109 cases of gastric carcinoma diagnosed at the State University of Iowa Hospitals in 1941 and 1942 were analyzed. Search was made for any information that might lead to the use of roentgen examination of the stomach earlier in the course of the disease, and also for any findings that might indicate resectability prior to operation or might aid in predicting survival. The roentgen examination was the most definitive of all diagnostic methods. One hundred and five of the cases received an upper gastrointestinal examination, and carcinoma of the stomach was diagnosed or suggested in 96 patients, or 91 per cent. Of the 9 errors, 2 were diagnosed as benign ulcers, and 1 lesion was described as carcinoma in the duodenal loop rather than the stomach. The other 6 were called normal stomachs. Most of the lesions occurred in the antrum and occupied both lesser and greater curvatures. Carman's meniscus sign was observed in only 4 of 96 examinations. Fore-

shortening of the lesser curvature was a frequent observation. The roentgen appearance of a lesion could not be used as an index of resectability. Large filling defects sometimes had limited extragastric extension, while small ones were found to be widely disseminated at operation.

The small bowel displayed disturbed motor physiology in 58 per cent of the cases, as judged from films taken immediately and five hours after the ingestion of barium. The duodenum and proximal jejunum always appeared normal but clumping, segmentation, and mucosal edema were observed in the distal jejunum and ileum. Transit time was ordinarily normal. Whether the small bowel disturbances were the cause or the effect of avitaminosis and hypoproteinemia associated with malignancy is a matter of conjecture.

It is evident that carcinoma of the stomach must be found while it is still asymptomatic. Dailey and St. John have conducted wide scale roentgen-ray screening experiments on symptomless males in the cancer age group. Dailey failed to find any gastric carcinoma in 500 men over forty-five. St. John found the incidence of gastric malignancy to be 1.24 cases per thousand, which is too low an incidence to make this type of examination practical as a screening procedure. In order to select a group more likely to have a higher incidence, Rigler limited his screening examinations to patients known to have possible precursors of gastric carcinoma—achlorhydria, a chronic gastritis, pernicious anemia, gastric polyps or a family history of carcinoma of the stomach.

Routine photofluorographic examination of the stomach is being tried experimentally but it is unlikely that any but the larger lesions will be discovered in this manner. The Papanicolaou smear technique has been adapted to gastric aspirations and can be used as an adjunct in all cases having gastric analysis or gastroscopy. Cell detail is surprisingly well preserved despite exfoliation into digestive juices; however, even in Papanicolaou's hands, a high percentage of cases were missed because of poor cell preservation and the failure of scirrhous carcinoma to shed cells. Further, the requirements of gastric aspiration make this method undesirable as a screening procedure.—*E. J. McDonald, M.D.*

Jungmann, H. J., and Cosin, Lionel. Some observations upon the radiology of the small intestine in old age. *Brit. J. Radiol.*, June, 1949, *22*, 325–330.

Eighteen males between the ages of seventy and ninety-one, without clinical evidence of gastrointestinal abnormality, were examined with barium for demonstration of the small intestine. All but one showed great variation from the normal. In 6 the transit time between the stomach and cecum exceeded four hours, and in 2 it was less. Eleven showed hypertonus, which was usually temporary; 3 showed hypotonus. Segmentation was found in 15. All these changes are characteristic of nutritional disorder. Ross Golden has suggested that these changes may be due to lesions in the intramural or submucosal nerve plexus. The possibility that the changes are due to arteriosclerosis, which produces anoxia of the nerve tissues either locally or in the pons, is to be considered. —*E. F. Lang, M.D.*

Young, A. Grenvills. Acute jejunitis. *Lancet*, June 11, 1949, *1*, 1005–1007.

This is a report of a single case of an acute jejunitis similar to the description of necrotic jejunitis by Fick and Wolken reviewed previously. The present case is that of a female, aged sixty-two, admitted with signs of acute intestinal obstruction at operation. The upper jejunum appeared grossly like a regional enteritis sometimes called a Crohn's disease and usually seen in the ileum. At the time of operation, a gastroenterostomy was performed which short circuited the affected jejunum. Three months after this admission, the patient was again seen with an acute intestinal obstruction. At the time of operation, a gangrenous loop of ileum was found strangulated by adhesions. At the time of this operation, the jejunum appeared entirely normal. Unfortunately, the patient died nine hours following the operation. This case is interesting in that it suggests the possible success of a short-circuiting operation such as used for acute regional ileitis.—*J. S. Summers, M.D.*

Bigelow, R. R., and Anlyan, A. J. Submucous lipomas of the colon. *Arch. Surg.*, July, 1949, *59*, 114–128.

The rarity of submucous lipomas of the colon is indicated in this report, and a survey of the literature shows a previously reported total of 155 cases. To this total the authors add 7 cases observed in the past eleven years at the University of Chicago Clinics. The incidence of submucous lipomas of the gastrointestinal tract at autopsy has been estimated by various authors as varying from 0.05 per cent to 0.75

per cent. Most of these lesions are usually single though instances of multiple tumors have been reported.

No tendency towards malignancy has been noted. The tumors are usually highly vascular and lobulated masses of adult type fat cells which are situated in the submucosa and appear as polypoid or sessile growths in the lumen of the bowel. The mucosa overlying them is usually flattened and atrophic from pressure, and there may be ulceration. Large lipomas sometimes show hemorrhagic cystic degeneration and inflammation or necrosis.

The tumors are most commonly seen on the right side of the colon, being most common in the cecum, ascending colon, sigmoid colon, transverse colon, rectum and descending colon in that order.

Clinical symptoms are not pathognomonic and may be secondary to the complications which are produced by these tumors, namely, obstruction, intussusception and hemorrhage. The most frequently reported symptom complexes are two: one is a chronic course of gradually increasing symptoms of intermittent obstruction, and the other is an acute obstructive process which is usually precipitated by intussusception.

In 2 of the authors' cases the lipomas were associated with carcinoma. Treatment is by local resection, enucleation, or by severing the pedicle. There are several excellent photographs and photomicrographs of tumors seen in these cases.—*John P. Glenn, M.D.*

Wisseman, Charles L., Lemon, Henry M., and Lawrence, Knowles B. Cytologic diagnosis of cancer of the descending colon and rectum. *Surg., Gynec. & Obst.*, July, 1949, *89*, 24–30.

A method for the detection of cancer of the large bowel based upon the cytologic recognition of exfoliated malignant cells in smears taken at sigmoidoscopy is described.

The range of usefulness was found to be limited to the rectum, sigmoid colon and lower descending colon where from two-thirds to three-fourths of the tumors were detected or suspected on the basis of the smears.

In this region the smear method compared favorably with roentgen examination and sigmoidoscopy with biopsy. It was possible to detect malignant cells from tumors which could not be seen through the sigmoidoscope.—*Mary Frances Vastine, M.D.*

Kalil, Toufic H., and Robbins, Laurence L. Early roentgenologic changes in idiopathic ulcerative colitis. *Radiology*, July, 1949, *53*, 1–10.

The authors reviewed all the roentgenograms, many of them serial studies, on a group of 160 patients with idiopathic ulcerative colitis in all stages proved by sigmoidoscopy, colectomy or autopsy.

The earliest roentgenologic signs of this disease are: (1) thickening of the mucosa suggested by a change in the normal irregular crinkling of the mucosal pattern, and (2) scattered to multiple tiny serrations along the edge of the bowel. Thickening of the mucosal folds is seen roentgenologically in that the folds are coarser and tend to become parallel demonstrated best on the post-evacuation roentgenograms. This change can be present in any irritative process. The second sign is the presence of superficial ulcerations of the involved lymphoid follicles. When filled with barium these are seen as scattered minute serrations in the involved areas often seen best in profile in the sigmoid and transverse colons. These must be distinguished from small particles of feces clinging to the bowel wall. The above two signs when combined are diagnostic of the early changes of the disease.

Adequate preparation is essential in this disease even though diarrhea may be present. Careful fluoroscopy is necessary, pre- and post-evacuation roentgenograms are routine and spot films are used as indicated.—*F. J. Rigos, M.D.*

Weber, Harry M. Significance of the intestinal polypoid lesion. *J.A.M.A.*, March 11, 1950, *142*, 693–697.

This is a very carefully considered presentation of the clinical significance of polyps of the colon. It should be read in its entirety by every radiologist. The author indicates that the incidence of carcinoma of the colon can be considerably reduced by the identification and removal of polyps which form a large portion of the premalignant lesions of the large intestine. He demonstrates instances where polyps have degenerated into a carcinoma over a period of several years, while under observation. He emphasizes the need for a careful sigmoidoscopic study because 60 per cent of the malignant and potentially malignant lesions of the large intestine occur in the lower portion of the bowel. Roentgen examination cannot take the place of

the direct digital and sigmoidoscopic study and should never be used to do so. The remainder of the large intestine must be meticulously examined by individualized methods which rely heavily upon the use of a double contrast study in order to show polyps even as small as 1 cm. in diameter.

Such an elaborate study cannot be made available to all patients sent for colon examination but should be available in all cases where bleeding, pain or change in bowel habits is noted. Even so there will be a number of patients in whom the presence of polyps or carcinoma will be overlooked because they have not produced any symptoms. Diligence on the part of radiologists will be necessary to discover these silent lesions but their efforts will be well rewarded because they will be contributing directly to the prevention of carcinoma.—*R. P. Barden, M.D.*

Swinton, Neil W., Hare, Hugh F., and Meissner, William A. Diagnosis of cancer of the large bowel. *J.A.M.A.*, June 4, 1949, *140*, 463–469.

Of all patients with malignant disease of the large bowel, 80 per cent will have rectal bleeding. Other important symptoms are abdominal pain and change in bowel function. These are the symptoms of advanced cancer while polyps which are precancerous may be entirely asymptomatic and only one-third of patients with polyps will have rectal bleeding.

Thorough sigmoidoscopic examination followed by adequate roentgen examination of the entire colon is necessary in all cases of rectal bleeding and in any other case when complete study of the colon is indicated.

The microscopic differentiation between benign and malignant polyps is discussed and the roentgenologic procedure is detailed. One hundred and sixty-one cases were reviewed for this paper and the roentgen examination was inaccurate in the upper rectum and sigmoid region in several patients.—*C. A. Stevenson, M.D.*

Norris, William J., Brophy, Truman W., and Brayton, Donald. Imperforate anus; a case series and preliminary report on the one stage abdominoperineal operation. *Surg., Gynec. & Obst.*, May, 1949, *88*, 623–634.

Roentgenography Prior to Operation. Because of the nature of the abdominoperineal procedure the earlier the patient comes to surgery, the less the distention and the simpler the operation. The Wagensteen and Rice technique for obtaining roentgenograms of the abdomen with the infant held head down and a marker at the anal dimple has been found inaccurate if done before the age of twenty-four hours. The films of 3 of the authors' patients taken at the ages of two, twelve, and fourteen hours respectively illustrated this error. In each case, at laparotomy, shortly following this diagnostic procedure, the rectal pouch was found to be at the level of, or just below, the pelvic peritoneal reflexion. In no case had the gas approached this region according to the films. To postpone the operation until accurate roentgenograms may be obtainable increases the hazard to the patient by increasing the difficulty of exposure at the time of surgery. The roentgen procedure is somewhat traumatic especially if the infant is held head down for some minutes and the abdomen massaged in an attempt to cause gas to enter the rectal pouch. The films give no information regarding the presence or location of high fistulas. For these reasons it is felt that preoperative roentgenograms may frequently be omitted in infants seen at an early age, in which the abdominoperineal operation is indicated.

Summary and Conclusions. The various types of congenital anal anomalies together with commonly associated fistulas are described. Fifty-two cases have been studied. In the majority of the patients, the rectum was found to end blindly at a varying distance from the perineum, the type III anorectal anomaly. The incidence of fistulas and of associated malformations of other systems is relatively higher within this group of cases than in the other types. The mortality and functional results of treatment are about the same in this series as in others reported in the literature.—*Mary Frances Vastine, M.D.*

Sengpiel, Gene W. Compatibility of castor oil and priodax in concurrent examination of the colon and gall bladder. *Radiology*, July, 1949, *53*, 75–80.

Because of the frequent desirability of combining gallbladder examinations and colon examinations, the author investigated the effect of castor oil on the gallbladder examination. One and one-half ounces of castor oil were given at 4 P.M., a light fat free supper at 5:30 P.M., and six priodax tablets at 6 P.M. Gallbladder examination was done at 8 A.M. the following

day and colon examination immediately following the conclusion of the gallbladder examination. Fifty patients were studied, ranging from seventeen to fifty-nine years of age. The actual interval between the administration of castor oil and the ingestion of priodax varied from forty-five minutes to four hours.

The density of the gallbladder shadow in these cases appeared to vary no more than in a comparable group in which castor oil had not been given. There appeared to be no definite relationship between the density of the shadow and the time interval between the administration of castor oil and priodax.

Forty-nine cases were interpreted as showing a normally functioning gallbladder. In 11 of these, cholecystography was repeated in the routine manner without castor oil for comparison. No significant difference was found in the visualization obtained by the two methods.

It appears safe to presume, therefore, that the gallbladder and colon can be examined concurrently without interference with either examination.—*Leslie K. Sycamore, M.D.*

Waggoner, Charles M., and LeMone, David V. Clinical and roentgen aspects of internal biliary fistulas; report of twelve cases. *Radiology*, July, 1949, *53*, 31–41.

In an extensive review of the literature, the authors found 819 reported cases of internal biliary fistula. Such fistulas were discovered during routine biliary surgery and 91 per cent were found to involve the duodenum or colon.

Cholelithiasis was the causative factor in 84 to 90 per cent of the reported cases; these involved primarily the gallbladder. Bile duct obstruction is the determining factor for fistula formation in these cases. Perforating duodenal ulcer accounted for approximately 6 per cent involving chiefly the common bile duct. Carcinoma of the gastrointestinal tract or the biliary tract may invade widely and produce an internal biliary fistulous tract.

There are very few findings pathognomonic of biliary fistula. Such signs as unusually severe biliary colic, recurrent symptomless periods and sudden cessation of colic with signs of sepsis have been considered. One definite sign is the presence of a sizable biliary calculus in the feces or vomitus.

Roentgen examination is the only method for definite preoperative diagnosis of internal biliary fistula. The presence of air or contrast material from the gastrointestinal tract in the biliary system is the fundamental criterion. In the authors' series of 12 cases, scout films of the abdomen played an important role in diagnosis, revealing abnormal air patterns in all cases involving the gallbladder. In cases of cholecystocolic fistula the air patterns on the survey films were adequate for final diagnosis. In cholecystoduodenal fistulas such patterns were less marked and usually sufficient for preliminary conclusion only. Air patterns were not observed in bile duct fistulas or fistulas associated with malignant growths. All fistulas, however, were easily demonstrated by barium studies of the gastrointestinal tract. Barium flowed into the biliary tree except in those cases where the fistula was blocked by a large calculus or malignant neoplasm.—*Wallace M. Roy, M.D.*

Hicken, N. Frederick, Coray, Q. B., and Franz, Bruce. Anatomic variations of the extrahepatic biliary system as seen by cholangiographic studies. *Surg., Gynec. & Obst.*, May, 1949, *88*, 577–584.

Roentgenographic studies of the extrahepatic biliary systems of patients during and after operations have been made. This was accomplished by injecting a solution of diodrast into the gallbladder or bile ducts and then taking a roentgenogram.

1. The gallbladder was found to occupy almost every position in the right side of the abdominal cavity. It was seen to lie under the eleventh rib, to be contiguous with the right lateral abdominal parietes, to be pushed so far medially as to superimpose the body of the third lumbar vertebra and even to hand down into the recesses of the pelvic cavity.

2. The cystic duct was seen to pass medially in a horizontal plane, to descend vertically downward toward the lateral border of the third lumbar vertebra, to ascend perpendicularly from a gallbladder situated in the pelvic cavity, or to describe a tortuous course as it passes mesially to unite with the common hepatic bile duct. It was noted that the cystic duct united with the right lateral wall, the anterior surface or even the left mesial wall of the common hepatic bile duct.

3. The common hepatic duct was usually noted as passing downward and medially to unite with the cystic duct. At times, however, it occupied a horizontal position.

4. The choledochus presented no uniform pattern. In some instances it descended in a vertical plane, again it was found to lie in a transverse position. Sometimes it appeared as a vertical tube. Then again it would present a "zig zag" outline, or even be so distorted as to resemble the letter "S." Occasionally it presented a tortuous contour, even transcribing semicircular forms. At times the choledochus was found to lie 2 inches lateral to the bodies of the second and third vertebrae or to be directly superimposed over these structures. In one instance it occupied a transverse plane throughout its entire length crossing to the left side of the vertebral column.—*Mary Frances Vastine, M.D.*

Ray, Bronson S., and Console, A. Dale. The relief of pain in chronic (calcareous) pancreatitis by sympathectomy. *Surg., Gynec. & Obst.*, July, 1949, *89*, 1–8.

Chronic (calcareous) pancreatitis is often accompanied by pain so intolerable that some surgical measure is necessary for relief. Total or near total pancreatectomy is one method of treatment but it is not always feasible and at best is accompanied by a considerable operative risk and further deprivation of endocrine and enzyme products. The alternative procedure of interruption of the pain pathways from the pancreas is a safer method and the side effects of the operation are not serious.

A review of the reports of differing procedures for interruption of the pain pathways from the pancreas, together with the authors' own experience in 5 cases of intractable pancreatic pain (4 cases of chronic calcareous pancreatitis and 1 pancreatic carcinoma) has led to the following conclusions:

1. Pain sense from the pancreas is mediated by visceral afferent nerves that traverse the celiac plexus, the splanchnics, and the sympathetic chains on both sides.

2. The vagus nerves play no part in the transmission of pain sense from the pancreas.

3. The principal pathway traversed by pain fibers from the pancreas is via the greater splanchnic nerves, but lesser splanchnic nerves, the lower portion of the thoracic chains, and possibly the upper portion of the lumbar chains may also serve as pathways.

4. The minimal operation thus far found to provide total analgesia of the pancreas and the one proposed as most suitable is bilateral resection of the ganglionated chains from the eleventh thoracic to the first lumbar and of the lowest 8 cm. of the greater splanchnic nerves.

5. Unilateral, right or left, sympathectomy may in some patients provide interruption of enough of the sensory supply to afford relief of pain.

6. While the operation is well suited to the relief of chronic pancreatitis it is of limited value in carcinoma of the pancreas chiefly because of the tendency of the disease to spread outside the organ to pain sensitive areas supplied by somatic sensory nerves.—*Mary Frances Vastine, M.D.*

Ayers, William B., Stowens, Daniel, and Ochsner, Alton. Fibrocystic disease of the pancreas; treatment by sympathetic denervation of the pancreas and presentation of a theory of neuro-effector mechanisms. *J. A. M. A.*, Jan. 7, 1950, *142*, 7–12.

Fibrocystic disease of the pancreas consists of fibrous replacement of the acini of the pancreas associated with severe nutritive and respiratory disease.

Since its recognition in 1938 advances in treatment have prolonged patients' lives using dietary measures, and supplementary and prophylactic measures against recurrent and intercurrent infection. A uniformly fatal prognosis of the disease has not been altered.

Three case histories are given wherein sympathetic denervation of the pancreas was achieved by splanchnic block with procaine hydrochloride and complete splanchnicectomy on the right side. This treatment shows promise of limiting the secondary and fatal complications of the disease.

Seven figures are presented including three with demonstrations of the so-called roentgen-ray film test for tryptic activity of duodenal fluid.—*J. H. Gilmore, M.D.*

Siler, Vinton E., and Wulsin, John H. Acute pancreatitis. *J.A.M.A.*, Jan. 14, 1950, *142*, 78–84.

Clinical manifestations of acute pancreatitis in 98 patients admitted to Cincinnati General Hospital between 1941 and 1948 are presented.

The disease as herein designated includes three clinicopathologic types, interstitial (edematous), hemorrhagic (necrotic), and suppurative (pseudocystic). The interstitial type, a relatively benign type, was usually self limiting

and only occasionally fatal, the hemorrhagic type tended to be rapidly fatal, and the suppurative type, those cases diagnosed at operation and necropsy, revealed signs of findings of intra-abdominal abscess or pseudocyst following an attack of acute pancreatitis.

Over one-half of the patients studied were younger than fifty-one years, the females constituting 58.6 per cent of the cases. Long history of indigestion, attacks of acute abdominal pain of short duration comparable to that present on admission, alcoholism, and trauma were associated in varying degrees with less frequent pain as cramping and intermittent or dull and ill-defined. Vomiting occurred in almost four-fifths of the cases. Vomiting suggestive of the disease made its appearance following the onset of pain and had a tendency to recur despite an empty stomach with a relatively low incidence of nausea. Gallbladder disease was associated in 34.2 per cent of all cases.

The most reliable laboratory information was obtained from the serum amylase which is abnormally elevated. The test was repeated daily or every other day until consecutive normal values were obtained. The intensity of amylase activity bore no relation to the clinical or pathological severity of the disease. The presence of glycosuria in 7.2 per cent of the cases pointed to severe damage of the pancreas and was most commonly observed in the group with suppurative lesions.

Roentgenographic studies were made both on admission and during the course of the illness. Preliminary examination of the abdomen in the majority of instances revealed nothing of significance, and even at times diverted attention from the pancreas by revealing calculi in the right upper abdomen. Information obtained from subsequent roentgenographic studies was helpful in revealing displacements of portions of the gastrointestinal tract by extrinsic pressure depending upon the portion of the pancreas involved. The stomach was displaced superiorly and anteriorly with frequent distortion of the antrum. The duodenal loop was often widened. Lesions in the tail of the pancreas tended to depress the left half of the transverse colon. In one case early diagnosis of pancreatic abscess with extension to the left subphrenic space was made possible by visualizing the relation of the fundus of the stomach to the left side of the diaphragm after a swallow of barium had been administered to the patient, who was then tilted into a low Trendelenburg position. All patients had cholecystography, when acute symptoms and indications of jaundice had subsided; 51.2 per cent showed poor visualization with 31.7 per cent revealing gallstones.

An emergency operation was not performed in the face of a known diagnosis of acute pancreatitis. Immediate surgical intervention occurred only in those patients who had been incorrectly diagnosed preoperatively or in whom operative intervention was deemed necessary to establish a diagnosis. Cholecystectomy was performed as an emergency procedure if presence of gallstones appeared to contribute to the acute illness. In 45 patients submitted to operation there was an operative mortality rate of 15.5 per cent and a total mortality of the entire series of 18 per cent.

Nonoperative treatment during the acute stage consisted of a conservative regimen of bed rest, withholding food and water with intravenous replacement therapy and of sedation. Penicillin, which was administered in 28 patients, did not appear to diminish morbidity in any striking manner.

The article includes ten tables and three figures in the form of graphs.—*J. H. Gilmore, M.D.*

Palumbo, L. T., Cross, K. R., Smith, A. N. and Baronas, A. A. Primary teratomas of the lateral retroperitoneal spaces. *Surgery*, July, 1949, *26*, 149–159.

The authors present a review of 57 cases of primary teratoma of the lateral retroperitoneal space, and add an additional one of their own. No theory of histogenesis is presented, although there is a brief reference to Speman's theory of embryonic primary organizers.

The medial boundary of the lateral retroperitoneal area is taken to be the vertebral column, and its inferior boundary the linea terminalis or white line of the pelvis. This concept excludes sacral teratomas from the group. The definition of a teratoma is given as a "true tumor or neoplasm composed of multiple tissues of kinds foreign to the part in which it arises." This definition is attributed to Willis. True tumor characteristics are borne out by the authors' findings that, after an unpredictable period of time, retroperitoneal teratomas become of clinical importance as a result of their growth. Because of the high incidence of tissue multiplicity, the ubiquitous term "dermoid cyst" is not used. In the 58 cases recorded

there was an incidence of malignant degeneration in 10 per cent. These neoplasms occurred twice as frequently on the left side as on the right.

The authors indicate that about 11 per cent of primary retroperitoneal tumors are teratomas. The average age of the patients was thirteen years; only 10 per cent of the tumors occurred in persons more than thirty years old. The oldest patient was fifty-three years of age. The lesions are slightly more common in females than in males.

Abdominal enlargement and a palpable mass are the most common manifestations. Symptoms are predominantly the results of pressure due to growth of the tumor. Preoperative diagnosis is usually not possible unless characteristic calcific deposits representing teeth or bone are demonstrable in the roentgenogram.

Since retroperitoneal tumors of all types are more frequently found in men, and usually occur in the fourth and fifth decades of life, the authors feel that the occurrence in the younger age group and the slight predominance of these tumors in women and girls are two factors of diagnostic significance. Although the over-all mortality rate in this group was 70 per cent, it was zero among those patients operated on in the past ten years.

The authors' patient was a white male, aged forty-three, in whom a roentgenogram of the abdomen showed an ovoid shadow of eggshell configuration overlying the apex of the shadow of the left psoas muscle medial to the left kidney. A small, dense, opaque shadow suggested a small fragment of tooth, and there was a second amorphous deposit of calcium. Intravenous and retrograde pyelograms showed lateral displacement of the left renal shadow. Pathologic examination showed that the tumor was a teratoma without evidence of malignancy. The patient made a satisfactory recovery.—*C. B. Holman, M.D.*

GYNEOLOGY AND OBSTETRICS

Rubin, I. C., and Myller, Ernest. Cervical obturation with inflatable cannula in uterotubal insufflation and hysterosalpingography. *Am. J. Obst. & Gynec.*, Dec., 1948, *56*, 1077–1082.

This paper introduces a new type cannula with an inflatable balloon for cervical obturation which satisfied the following prerequisites of the authors: (1) painless application unaccompanied by trauma; (2) air tight obturation of the cervical canal; (3) maintenance of the normal anatomical position of the uterus.

The cannula and its use in insufflation of the tubes and hystereosalpingography is described in detail and illustrated by drawings and roentgenograms.

It provides an automatic safety valve which prevents undue increase in intrauterine pressure. Boiling sterilizes the instrument. The rubber bulb will withstand many boilings but its cost is so low that it is feasible to replace it for each examination.—*Mary Helen Cameron, M.D.*

Palmer, James P., Sadugor, Marvin G., and Reinhard, Melvin C. Carcinoma of the vulva; report of 313 cases. *Surg., Gynec. & Obst.*, April, 1949, *88*, 435–440.

Cancer of the vulva is considered to be a relatively rare malignant tumor. From the authors' records of approximately 8,000 gynecological malignant tumors, the incidence of cancer of the vulva is 3.88 per cent of all cancers of the female genitalia. As shown by Pack the incidence is only one-half of one per cent of the total number of cancers, or 3.2 per cent of all cancers of the female genitalia.

Three hundred and thirteen cases of carcinoma of the vulva were evaluated for statistical purposes.

1. The average age at admission was 61.5 years. The youngest was six and the oldest ninety-six.

2. Eighty per cent of the patients had passed the menopause which indicates that carcinoma of the vulva is predominantly a postmenopausal or so-called degenerative disease.

3. There was a ratio of 10 married to 1 single patient.

4. No women of Negro or Jewish extraction were found in the series.

5. The primary complaint occurring in 106 patients was itching and pruritus. The next commonest was swelling or perception of the lesion by the patient herself.

6. Leucoplakia was present in only 12 per cent of the cases.

7. The histopathological forms or types present in this series were as follows: epidermoidcarcinoma, 300; malignant melanoma, 7; adenocarcinoma, Bartholin's gland, 1; myosarcoma, 1; and basal cell carcinoma, 4. It is seen that over 95 per cent of vulvar cancer cases in this series were epidermoid in origin.

8. Surgery seems to be superior to irradiation in the treatment of this disease. However, thus far no marked advantage has been proved for the more radical type of surgery (Basset).

9. The authors are of the opinion that there is no adequate clinical classification that uses all factors influencing end results and no clinical classification that is generally accepted.—*Mary Frances Vastine, M.D.*

Kernodle, John R., Cuyler, W. Kenneth, and Thomas, Walter L. The diagnosis of genital malignancy by vaginal smears. *Am. J. Obst. & Gynec.*, Dec., 1948, *56*, 1083–1089.

This paper gives the results of 6,753 smears made on 1,709 patients examined. Vaginal and cervical smears were made on all cases, and frequently an endocervical or endometrial smear. Procedures for obtaining, staining, and classification were done according to the methods of Papanicolaou and Traut.

By pathological examination 124 of the above patients were shown to have malignancies; 114 of these 124 were diagnosed by vaginal smears giving an error of 8.1 per cent. Of those missed, 3 cases were due to insufficient tissue or poor fixation, 3 to the fact that smears were taken after roentgen therapy, and in 4 cases, the cancer cells were present in the smear but not recognized.

Of the remaining 1,585 cases, false positive reports were given in 34, resulting in an error of 2.1 per cent.

Proper interpretation of such smears is difficult and should be under the supervision of a trained cytologist. Malignant appearing cells and nuclei of benign conditions often complicate the diagnosis. Such cells include the "precancerous" cells of Ayre, cells with hyperchromatic irregular nuclei in cases of chronic vaginitis and cervicitis, intrauterine cells in cases of incomplete abortion, and cases showing pyometra. The accurate diagnosis of adenocarcinoma of the endometrium is the most difficult.

The authors state that their results show improvement in direct relation to their experience. They emphasize that at the present time every positively diagnosed smear should be confirmed by pathologic tissue examination, before the commencement of therapy.—*Mary Helen Cameron, M.D.*

Brunschwig, Alexander, and Pierce, Virginia. Necropsy findings in patients with carcinoma of the cervix; implications for treatment. *Am. J. Obst. & Gynec.*, Dec., 1948, *56*, 1134–1137.

The autopsy records of 65 patients having cervical carcinoma who died at the Memorial Hospital from 1917 to 1948 were reviewed by the authors.

Of these 65 cases, 32 showed macroscopic spread beyond the pelvis. Periaortic node metastases were present in 24 of the 32. These nodes were the only involved areas in 9 per cent of the 24. The remaining cases showed additional sites of spread to one or more of the following: lungs and mediastinum, liver, cervical and peripancreatic lymph nodes, left adrenal gland, peritoneum, intestinal serosa, spleen, thoracic wall, subcutaneous tissue, and kidney. No metastases to periaortic nodes were noted in 6 cases. In 12 instances death was due to uremia or pyonephritis. Peritonitis was responsible for death in 6, septicemia in 4, tuberculous bronchopneumonia in 1, empyema in 1, intestinal obstruction in 2. The cause of death was not stated in 6 cases.

In 33 of the 65 cases, no gross metastases beyond the pelvis were discovered. In 10 of these, the cause of death was ascribed to peritonitis. Five died from pelvic abscesses, 2 from septicemia, 2 of pneumonia, 2 of septic pulmonary edema, 6 of uremia, 1 of large bowel hemorrhage, and 1 of pernicious anemia. The cause of death was not discovered in 2 instances.

In 41 of the 65 cases ureteral obstruction with hydronephrosis was found. It seems that ureteral involvement occurs naturally as a result of uncontrolled cervical cancer.

Nearly all of these 65 patients were treated by irradiation. Recurrent or residual cervical neoplasm was present in 52. No cervical residual was found in 6 cases but there were extrapelvic metastases. In 5, neither primary residual nor metastases were noted. Irradiation necrosis accounted for the death of 5 patients.

It is evident from the autopsy findings that extrapelvic metastases occur primarily by lymphogenous channels. The periaortic lymph nodes are first involved in the majority of cases. It then appears that lymphatic blockage should be of nearly as much importance in the treatment of these cases as eradication of the primary lesion. Apparently, there are limitations in the use of irradiation in this respect.

Ureteral obstruction secondary to pelvic neoplasm causes uremia which, in turn is the immediate cause of death in a high percentage

of cases. Maintainence of urinary tract function should be an important aspect in prolonging life.

Prevention of infection would also be a helpful measure in prolonging life.—*Mary Helen Cameron, M.D.*

Speiser, Mortimer D. Four cases of granuloma inguinale of cervix diagnosed clinically as carcinoma. *Am. J. Obst. & Gynec.*, Dec., 1948, *56*, 1181–1183.

Cervical involvement by granuloma inguinale is very similar in appearance to that of carcinoma. The ulceration may vary in appearance from that of a granular lesion to a polypoid and fungating mass. It is always sharply circumscribed. In consistency it may be soft or indurated. Involvement of deeper tissues may produce a frozen pelvis. Bleeding is frequent. It spreads by way of the lymphatics and direct invasion. Remote osseous involvement has been described. Hematogenous spread also occurs.

The author reports 4 cases of cervical granuloma inguinale which were thought clinically to be carcinoma. Demonstration of the pathognomonic cell containing Donovan bodies established the correct diagnosis. In all cases of clinical cervical carcinoma not proved by microscopy, material should be studied for the "granuloma" cell.—*Mary Helen Cameron, M.D.*

Davis, G. Hamilton, Howe, John S., and French, Willard G. Leiomyosarcoma of the uterus; report of 16 cases, 1917 to 1948. *Am. J. Obst. & Gynec.*, Dec., 1948, *56*, 1048–1058.

The authors review 16 clear cut cases of uterine leiomyosarcoma found during the last thirty years at the Methodist Hospital, Brooklyn, New York. Fourteen of the 16 cases arose in leiomyomas. In this series 0.69 per cent represented the ratio of leiomyosarcomas to leiomyomas which is comparable to that of larger series.

Because of the infrequency and the difficulty in gross pathological diagnosis the correct diagnosis is seldom made at the time of surgery. The authors suggest criteria to aid in diagnosis at the time of surgery and at the microscope under the headings of gross criteria, histologic criteria, and clinical data. Two grades of malignancy are assumed, unequivocal leiomyosarcoma and low-grade leiomyosarcoma.

Of the 16 cases, 14 were grossly different in appearance from leiomyoma by consistency, color, loss of fasciculation, and gross invasion. Sarcoma arising in pre-existent leiomyoma and primary sarcoma arising in myometrium comprise the gross division of leiomyosarcoma. The incidence of the two types varies greatly in different reported series.

As regards the histologic criteria, there are many differences of opinion among pathologists. The present series was studied according to the following: cellularity, anaplasia, pleomorphism, relative frequency of tumor giant cells, and of mitotic figures, and invasiveness. Each case was rated from one to four plus for each of the above criteria and the sum averaged. This figure represented the histologic grade.

Further analysis of the four tumor grades revealed two main groups. Unequivocal sarcoma is the term proposed for the first group which was made up of grades three and four. For the second group, the term low-grade leiomyosarcoma is offered. This group is made up of grades one and two and demonstrates less incidence of malignancy. The authors feel that this group should not be thought of as clinically benign.

Clinical data are tabulated as to the age range, and the signs and symptoms, which include menorrhagia, metrorrhagia, post-menopausal bleeding, abdominal pain, watery diarrhea, weight loss, enlarging mass and severe anemia. Most cases fall in the forty-fifty year age period, with the average age being 47.2 years. In all cases a mass was palpable on pelvic examination. Five of the 16 cases had a severe anemia.

Two patients, still alive, had recurrences, the structure of both being identical with that of the primary lesion, and the smooth muscle origin proved by Masson's stain.

All the deaths which occurred were in the unequivocal sarcoma group. There was evidence of spread found at autopsy, or by operative or roentgen findings.

The authors suggest that frozen section be done on those leiomyomas which are of unusual color or are soft and friable, so that complete surgery may be carried out. They also suggest that if the omentum is adherent to a leiomyosarcoma, the omentum be widely excised. Spill of tumor may follow a too limited surgical approach such as cutting through a "degenerated leiomyosarcoma." They believe that round ligament or adnexal traction is safer than tenaculum traction on the uterine tumor.

Metastasis occurs by blood stream and direct invasion. One case showed lymphatic spread.

Fundal sarcoma rarely recurs in the cervical stump if the excision is well below the lesion; however, the authors feel that total hysterectomy with bilateral salpingo-oophorectomy is surgery of choice.—*Mary Helen Cameron, M.D.*

GENITOURINARY SYSTEM

Fleming, John. An epidemic of acute nephritis. *Lancet*, May 7, 1949, *1*, 763–766.

The author's primary subject is acute glomerular nephritis, but incidental to the findings in his series of 159 cases is the presence of 24 cases (15 per cent) in which routine roentgenography of the chest revealed a pulmonary consolidation.

In only 1 case could the pneumonic lesion be claimed as one of direct bacterial infection. In this case, the symptoms, signs, and roentgen findings confirmed a diagnosis of streptococcal pneumonia which may well have been the primary lesion.

In all of the other cases, a pneumonic lesion was merely of secondary importance and appeared to have no influence on the course of the acute nephritic syndrome. It is therefore suggested that the lung lesions were areas of congestion and edema of the same nature as the congestive lesion of the kidney, but without leukocytic or fibrinose infiltration, and therefore capable of rapid resolution. The lung lesions were noted to resolve rapidly and completely in two or three weeks regardless of whether or not penicillin was used.—*J. S. Summers, M.D.*

Muirhead, E. E., Vanatta, J., and Grollman, A. Papillary necrosis of the kidney; a clinical and experimental correlation. *J. A. M. A.*, March 4, 1950, *142*, 627–631.

This report is based upon three clinicopathologic reports of patients suffering from papillary necrosis and experimental studies which elucidate the pathogenesis of this disorder.

Each of the 3 patients came to autopsy and the postmortem findings showed papillary necrosis of the kidneys. One of the patients was an uncontrolled diabetic. Two of the 3 cases were associated with severe hydronephrosis.

The experimental animals were subjected either to unilateral ureteral ligation followed subsequently by contralateral nephrectomy or to bilateral ureteral ligation. Studies were also made of the circulatory disturbance in the kidney by increased intrapelvic pressure.

The results of these experiments are discussed in detail and the authors conclude that papillary necrosis of the kidney in acute obstruction of the urinary tract is due to ischemia resulting from the application of pressure to a morphologically vulnerable zone. The occurrence of pyelonephritis in cases of papillary necrosis in obstructive uropathies is considered to be secondary to the necrosis induced by obstruction. However, in the papillary necrosis observed in diabetic persons the infection appears to be primary, the interstitial inflammation resulting in the papillary necrosis.—*J. H. Harris, M.D.*

Lich, Robert, Jr., and Grant, Owsley. Retrocaval ureter. *Arch. Surg.*, July, 1949, *59*, 84–91.

Another case of retrocaval ureter is added to the literature and the symptomatology, diagnosis, and treatment are briefly reviewed by the authors.

The anomalous relationship of the ureter and the vena cava is a very rare one and is due to a vascular variation in that one of the embryonic veins persists during the formation of the vena cava producing ureteral obstruction. Symptomatically, the complaints of the patients are those of ureteral colic or intractable pyelonephritis and hematuria. A few of the patients have been asymptomatic.

They state that the most suggestive diagnostic criteria are: (1) in the lateral view the ureter lies anterior to the vertebral column in the region of the third or fourth lumbar vertebra; (2) stereoscopic pyeloureterograms demonstrate the ureteral curvature and its relationship to a structure which corresponds with the vena cava; (3) the ureter is displaced toward the midline and overlies the bodies of the third and fourth lumbar vertebra; (4) there is a cresent-like curve in the upper portion of the ureter at which point there may be obstruction resulting in dilatation of the ureter and collecting system proximally; (5) the lesion is usually located on the right side and there has been only one case in which it is reported as having been bilateral. Most cases have occurred in males.

Of the previously reported 36 patients, 6 were treated with primary nephrectomy, 1 with

a secondary nephrectomy, and in 7 instances there were various types of plastic procedures done on the ureters. If abnormality was not of obstructive significance, no treatment was done. The authors' case was subjected to nephrectomy and ureterectomy because of an inadequately functioning kidney.—*John P. Glenn, M.D.*

Miller, J. A., and Cordonnier, J. T. A spontaneous perirenal hematoma associated with hypertension. *J. Urol.*, July, 1949, *62*, 13–17.

The authors review the literature on spontaneous perirenal hematoma and report a case associated with hypertension. In over 80 per cent of the reported cases the hematoma was extrarenal. Diseases of the kidney lead in the causative factors, with diseases of the blood vessels next. Symptoms are vague unless the hemorrhage is sudden and severe. In slow hemorrhage the only symptom is gradual development of a mass. In sudden hemorrhage severe renal pain and shock occurs.

The authors' case was a thirty-four year old male whose main complaint was of hypertension. He had had a sympathectomy at which time the presence of a large kidney was noted. This mass was readily palpable clinically. A urogram showed a large spherical calcified mass in the region of the right kidney. The renal pelvis was distorted and compressed toward the midline. A diagnosis of subcapsular renal hematoma with calcification was made and confirmed by nephrectomy. The hypertension disappeared following operation.—*Rolfe M. Harvey, M.D.*

Ney, Charles, and Horowitz, William. Complications with the use of a parasympathetic-stimulating drug. Development of acute pyelonephritis in neurogenic bladder. *J. A. M. A.*, Jan. 7, 1950, *142*, 12–15.

This is a case report on 2 patients wherein a parasympathetic-stimulating drug was given in the presence of large amount of residual urine. Vesicoureteral reflux produced acute pyelonephritis, the authors believe, by backflow of urine up the ureter into the kidney from a bladder forcibly contracting against a ureteral resistance greater than the reflux resistance.

The authors believe the use of any parasympathetic-stimulating drug is contraindicated if a large amount of residual urine and vesicoureteral reflux is present.—*J. H. Gilmore, M.D.*

Gibson, H. M. Ureteral reflux in the normal child. *J. Urol.*, July, 1949, *62*, 40–43.

There has been considerable controversy in the literature as to whether ureteral reflux can occur in the normal genitourinary tract. Campbell has reviewed several hundred cystograms on children and concluded that reflux does not occur in the normal child. The author performed cystograms in 43 children without urological complaints. None of the patients were anesthetized. Two cases of ureteral reflux were found. One patient was thirteen months old and the other sixteen months. Neither patient was cystoscoped. The author emphasizes that a cystogram does not constitute positive evidence of reflux since the medium might not be in the ureter when the films were exposed even though reflux was present.

The author concludes from his work that ureteral reflux can occur in the normal genitourinary tract of children.—*Rolfe M. Harvey, M.D.*

Teasley, G. H. Cystitis emphysematosa. *J. Urol.*, July, 1949, *62*, 48–51.

The author summarizes the available literature on cystitis emphysematosa and adds the 44th reported case to the literature. The patient had an *E. coli* infection as well as diabetic hyperglycemia. Trauma apparently has little part to play in the etiology.

The excretory urogram of Teasley's patient showed numerous small air bubbles in the region of the bladder. These air bubbles were noted to change position according to the amount of filling of the urinary bladder. The cystoscopic findings are typical. Illustrative films are reproduced.—*Rolfe M. Harvey, M.D.*

Sauer, H. R., and Burke, E. M. Prognosis of testicular tumors. *J. Urol.*, July, 1949, *62*, 69–74.

The authors reviewed a series of 202 cases of testicular tumors in accordance with the criteria adopted by the Army Institute of Pathology. Of the cases 46.9 per cent were seminomas; 34.6 per cent were embryonal carcinomas; 13.4 per cent teratocarcinomas; and the remaining cases adult teratomas, choriocarcinomas, and classified as miscellaneous. There was an over-all cure rate of 47.5 per cent.

The prognosis was found to depend on histopathology, biological properties, stage of the disease when treatment was instituted, and

method of treatment. The prognosis was found to improve in direct proportion to the degree of differentiation of the tumor cells. The prognosis was therefore best in adult teratomas and seminomas, and poorest in embryonal carcinomas and chorio-epitheliomas. The more lymphoid stroma which was present, the more favorable the outlook. The reason for this is not certain. A positive Ascheim-Zondek test, based on a complete hormonal assay of a twenty-four hour urine sample indicates a grave prognosis while a negative test has no prognostic significance. A positive test routinely turned negative during a course of deep roentgen therapy.

Rapid growth of the tumor is of poor prognostic significance. When metastatic lesions respond rapidly to roentgen therapy in small doses the prognosis is more favorable. If metastases were widespread when the disease was first discovered the prognosis was poor regardless of radiosensitivity. Backache was of bad prognostic significance and was often an early sign of metastases. A patient who survives for five years without evidence of disease should be considered a probable cure.—*Rolfe M. Harvey, M.D.*

SKELETAL SYSTEM

Fisk, Geoffrey R. Bone concavity caused by a ganglion. *J. Bone & Joint Surg.*, May, 1949, *31B*, 220–221.

The association of a simple ganglion with underlying bone change is unusual, and in a review of the literature, Fish was unable to find any record of a case similar to the one he reports. The patient was a Polish airman, aged forty-four, complaining of a cystic swelling of four years' duration in the region of the left medial malleolus. Roentgenographic examination showed a cup-shaped depression in the bone just above the medial malleolus, within which the tumor was found to be lying when it was exposed at operation. Microscopical diagnosis confirmed the diagnosis of ganglion. It appears probable that the ganglion arose from the periosteum and caused erosion of bone before bursting into the subcutaneous tissue.—*R. S. Bromer, M.D.*

Snedecor, Spencer T., and Wilson, Harrison B. Some obstetrical injuries to the long bones. *J. Bone & Joint Surg.*, April, 1949, *31A*, 378–384.

Eleven cases of trauma to the long bones through the force of breech extraction are reported. The long bones receive their greatest injury at the epiphyses and by subperiosteal fracture stripping of the tissues adjacent to them. The authors conceive the mechanism of the injury to be the strong manual pull and torsion strain exerted on the lower limbs when a baby is delivered by a breech first. The extraction force is often exaggerated by the urgency of the delivery and is likely to be carried out in a straight line, which necessarily causes severe torsion on the lower extremities, as the body of the baby must rotate at its weakest point; the epiphysis and the periosteum and muscles strip off down or up the diaphysis as the case may be. The greatest periosteal separation occurs at the epiphysis. Within five to ten days a proliferation calcification takes place in the hemorrhage surrounding the epiphysis or under the periosteum, and becomes evident roentgenographically.

The significant roentgenographic characteristics of the lesion are dense shadows of calcification surrounding the epiphysis, if separation or torsion has occurred there, and subperiosteally, if the muscles and periosteum have been pulled away from the bone. In 3 of their cases, both sites became calcified, indicating extensive involvement of both. Roentgenograms of other cases in their series demonstrated stripping along the shafts of both the femur and the tibia. In 1 case, the capital epiphysis of the femur was involved, following a delivery with the arm in an extended position beside the head. Roentgenographic evidence of calcification in the hemorrhage is found usually on the fifth to the seventh day.

The prognosis is relatively good for spontaneous recovery without specific treatment in most instances, but permanent epiphyseal growth change may take place occasionally.—*R. S. Bromer, M.D.*

Kelikian, H., and Lewis, Elbert Kenneth. Arthrograms. *Radiology*, April, 1949, *52*, 465–487.

This is a detailed discussion of the use of air injections of joints as a contrast medium for revealing pathology in various joints. The discussion is based on seventeen years' experience with the method used in over three thousand joint air injections.

The most common joint injected is the knee; however, the method can be used to advantage in the ankle, acromioclavicular, hip, and elbow joints. Roentgenographic technique is outlined

as well as the details of the actual method of injecting the air into the various joints. The authors survey the anatomy of knee as revealed by the arthrogram and the various pathological entities visualized by the use of this method of examination. Lesions of the knee that can be diagnosed with a great degree of accuracy are: lesions of the semilunar cartilages, synovial outpouchings, osteocartilaginous bodies, foreign bodies, rheumatoid arthritis, pigmented villonodular synovitis, tumors, intra-articular chip fractures and lesions confused with them, and avulsion ossicles.

While the article deals with its use in various joints, the discussion and photographs deal mainly with knee arthrograms.—*E. A. Addington, M.D.*

Wood, Franklin J. Tomography of bones and joints. *Proc. Roy. Soc. Med.*, London, Dec., 1948, *41*, 856–857.

The value of tomography in the roentgen examination of the spine, ribs, sternum and hip joints is discussed.

Tomography of the lower cervical and upper dorsal vertebrae is of great value in clearly visualizing tuberculous involvement in this region of the spine. Plain roentgenograms show these regions to poor advantage. Tomograms made in the anteroposterior position will give a good picture of the upper cervical region. Routine lateral films are usually sufficient for diagnosis. The condition of the spine even in the presence of marked kyphosis and considerable bone changes is well shown in the tomogram. Usually more disease is present than suspected from examination of plain films.

Tumors of the ribs can be demonstrated in greater detail by tomography than by any other method. The sternoclavicular joints and the sternum are easily shown on the tomogram. The technique for visualization of the sternum is described.

The tomogram may be used in conjunction with the usual anteroposterior and lateral views to show tuberculous foci in the acetabulum or neck of the femur. Three roentgenograms illustrate this article.—*D. R. Bernhardt, M.D.*

Warrick, C. K. Polyostotic fibrous dysplasia; Albright's syndrome; a review of the literature and report of four male cases, two of which were associated with precocious puberty. *J. Bone & Joint Surg.*, May, 1949, *31B*, 175–183.

Four cases of polyostotic fibrous dysplasia are reported in this paper. All were males, all showed pigmentation of the skin and in 2 there was precocious puberty. In the paper the nomenclature of the disease, clinical features, roentgenographic appearances, pathology, etiology and differential diagnosis are discussed. Diagrams to show the distribution of the lesions in the skeleton in 3 cases are given. In the section on differential diagnosis, differentiation from hyperparathyroidism, Paget's disease, Ollier's disease, osteogenesis imperfecta tarda and lipoid reticuloses is given in some detail.

In the roentgenograms multiple localized lesions with normal bone elsewhere were shown. The disease, however, may be monostotic, monomelic, unilateral or bilateral. The vertebral column was rarely affected. Areas of rarefaction were found which resembled true cysts. The affected bones showed a ground glass appearance in which homogeneous areas of increased or decreased density were present with thinning of the overlying cortex. The base of the skull often may show enormous hypertrophy of dense bone which may obliterate the nasal sinuses and compress the cranial nerves. Great thickening of the calvarium may also occur, often resembling Paget's disease and especially when involving the base of the skull may present a striking feature which is of diagnostic importance.

The disease does not reduce the expectation of life. Fresh lesions, Warrick states, cease to appear after puberty is reached. No medicinal therapy has been found to have any effect upon the disease, and treatment is necessarily limited to the management of fractures and deformities.

Excellent roentgenograms of 2 of the patients are reproduced.—*R. S. Bromer, M.D.*

Hart, Vernon L. Congenital dysplasia of the hip joint; relationship between congenital subluxation and congenital dislocation. *J. Bone & Joint Surg.*, April, 1949, *31A*, 357–372.

If, during embryonic or fetal life, a flat and shallow socket forms or a primary dysplasia of of the acetabulum occurs because of genetic and biochemical influences, either alone or in combination, five possibilities exist for subsequent growth of the hip joint. First, there may be complete displacement between the femoral head and the maldeveloped acetabulum with

clinical, roentgenographic and pathological findings of classical posterior dislocation or superior dislocation of the hip. Second, the displacement between the femoral head and the flat socket may be incomplete, but always with some contact of the articular surfaces of the head, socket, and limbus, and without capsular interposition. This condition, known as congenital subluxation, is also a distinct clinical, roentgenographic, and pathological entity. It is now an established fact that congenital subluxation of the hip, which was thought to be only a precursor of the classical dislocation, may remain throughout life as a permanent and eventually a disabling deformity. Third, there may be no displacement between the femoral head and the shallow acetabulum. This condition also may be a definite clinical entity and remain as such throughout life. These three hip-joint entities are identical in their etiology, but differ in their clinical and roentgenographic manifestations. The fourth is a rare entity, associated with extreme dysplasia, shortening of the shaft of the femur, and irreparable malformations of all structures of the hip joint. All four entities are definite clinical expressions of congenital dysplasia of the hip joint and have a common etiology. The fifth, the dysplastic hip, with no treatment may return to normal during either intrauterine life or early infancy, as a result of the rare phenomenon of spontaneous recovery.

The author states the purpose of this study is first, to focus attention on congenital subluxation, which is frequently unrecognized as a distinct entity and often coexists with classical dislocation of the opposite hip; and second, to establish the common eitology of the two conditions.

During the period of infancy, dysplasia of the hip with subluxation is common; with dislocation, is rare. A favorable mechanical and functional position, obtained by treatment during infancy before weight-bearing, not only enhances the potential growth power of the maldeveloped hip joint, but also prevents secondary pathological changes. The infant with subluxation presents well known clinical and roentgenographic changes by which the condition may be diagnosed. A flat and inadequate socket with sloping acetabular roof and delayed ossification of the ischiopubic junction may be demonstrated in roentgenograms. Later after the fourth month, there may be, in addition, delayed ossification of the center of ossification of the femoral head, and slight upward and lateral displacement of the femoral head from the socket. The lower extremity of the affected hip may lie in a position of adduction due to adductor contractures, and Shenton's line may be disturbed.

Residual subluxation is a partial displacement of the femoral head from the socket, subsequent to closed or open reduction of a dislocation. This is a common complication following reduction, but one to be expected if later there is insufficient development of the acetabular roof. If the residual subluxation does not continue toward displacement with weight-bearing, but remains a fixed and permanent condition, it may then be compared with the congenital subluxation which is also fixed and permanent, and the two conditions are then the same in many anatomical and mechanical features. There is usually good stability and function during childhood, adolescence, and early life, but during middle adult life serious disability begins. Osteoarthritis is then superimposed, because of the trauma of instability and the incongruity of the functioning articulation over the years. At this stage the clinical, roentgenographic and pathological features of arthritis deformans are the same in the two entities.

Hart believes that arthrographic studies should be reserved for scientific research. Clinical and roentgenographic findings are sufficiently accurate for all practical purposes. He states he is familiar with only one genetic investigation which provides accurate and scientific evidence of a relationship between subluxation and dislocation of the hip. He quotes Faber who based his concept on the fact that the hereditary factor, upon which dislocation depends, is not the hip dislocation itself but instead is a primarily existent defect in the joint, designated by Hilgenreiner as congenital dysplasia of the hip joint or a flat socket. Subluxation, as well as dislocation, is a consequence of the primary genetic dysplasia or incompetent acetabulum. Faber reported his roentgenographic studies of the families of 10 children with classical dislocations, who were considered ostensibly sound in their heredity. All genetic studies made prior to Faber's contribution had been founded on the concept that the dislocation was an inherited trait. They had been based only upon data of actual clinical dislocations of patients whose parents or relatives also had dislocations.—*R. S. Bromer, M.D.*

Josey, A. Izard. Headache associated with pathologic changes in cervical part of spine. *J.A.M.A.*, July 16, 1949, *140*, 944–949.

This report deals with a group of 20 patients with symptoms of headache. The author deduces from a careful history that trauma (many times apparently insignificant as far as the patient is concerned) produces an injury, such as a sprain, to the paravertebral ligaments. This is manifest in the lateral roentgenogram by diminution of the normal lordotic curve. This straightening of the spine is thought to be due to reflex muscle spasm. Arthritis may be present, but not necessarily so, and is usually a late finding. He believes the headache is the result of irritation in the muscles, fascia, and ligaments distributed by the upper three cervical nerves and the ninth and tenth cranial nerves. Treatment recommended for severe cases is a cervical collar and head halter traction.—*Robert K. Arbuckle, M.D.*

Gaunt, Raymond T. Retarded growth of limbs as a sequel of encephalitis lethargica. *Lancet*, June 18, 1949, *1*, 1049–1051.

The effect of neurological disorders, especially poliomyelitis, on the growth of limbs affected in childhood is well recognized. A similar sequel to encephalitis lethargica does not seem to have been described. The present report is on 3 cases of this type which show that growth may be retarded in diseases where the extrapyramidal tracts are predominantly affected. The exact cause of this retardation is not completely understood.

The present report covers 3 cases, all less than fourteen years of age. Multiple roentgenograms show the difference in the growth of the bones, the affected side being quite definitely shorter in each case. Roentgenograms of the hands and forearms are used in each case. Measurements of the hands are taken from the base of the third metacarpal to the distal end of the distal phalanx, third finger, and the length of the radius is measured from its two articular surfaces. —*J. S. Summers, M.D.*

Holt, John F., and Owens, William I. The osseous lesions of sarcoidosis. *Radiology*, July, 1949, *53*, 11–30.

A short introduction shows the evolution of sarcoidosis from a dermatologic entity, as described by Boeck, to the myriad of diseases, as we know it today, involving every tissue of the body except the hair and nails.

No attempt is made in this article to describe in detail the cause or clinical findings. For that information the author refers to a number of references, of which there are a total of fifty-nine, dating back to 1889 and 1899.

There is a detailed historical review about osseous lesions beginning with the first description by Kienböck in 1902 but recognized first by Kreibich in 1904.

Since sarcoidosis has a predilection for the phalanges of the hands and feet, especially the feet, the authors feel that only by routine examination of those parts in suspected sarcoidosis can greater accuracy be attained in the diagnosis.

Roentgenologic manifestations of osseous sarcoid to date are uncommon and found in only 16 per cent of total number of 65 patients studied at the University of Michigan.

Eighteen roentgenograms accompany two pages describing the appearance of the lesions in bone. The authors point out that roentgenologically the more characteristic and pathognomonic picture is manifested as a diffuse, coarse, reticular type of bone destruction producing an alveolate or lace-like appearance and not the punched-out circumscribed lesion which has been publicized widely.

Five case reports are given. In the differential diagnosis thirteen diseases are included.—*Anthony F. Rossitto, M.D.*

Thompson, Edgar A., Walker, E. Thayer, and Weens, H. Stephen. Iliac horns; an osseous manifestation of hereditary arthrodysplasia associated with dystrophy of the fingernails. *Radiology*, July, 1949, *53*, 88–92.

The posterior iliac horns are bilateral osseous processes on surfaces of iliac bones. The authors call attention to significant variants encountered in patients who show iliac horns. The associated findings which may be expected include:

1. Absent or underdeveloped thumb nails.
2. Longitudinal fissures with divisions of nails of index digits or other deformities of nails generally.
3. Hypoplasia or absence of patellae.
4. Flaring of iliac bones.
5. Unilaterally shortened radius was observed in one patient.

Iliac horns with various associated deformities as listed above appear to be transmitted as

a dominant hereditary characteristic, not sex linked.

The case histories and illustrations included in this article seem to substantiate the conclusion that osseous iliac horns are hereditary manifestations of a type of arthrodysplasia with fingernail dystrophy.—*John W. Turner, M.D.*

Pohle, Ernst A., and Frank, Ralph C. Radiation osteitis of the ribs; report of a case with fractures appearing four and one-half and eleven years after therapy. *J. Bone & Joint Surg.*, July, 1949, *31A*, 654–657.

A case is reported of radiation osteitis in which fractures of the ribs appeared four and one-half and eleven years, respectively, after the initial postoperative roentgen therapy for carcinoma of the breast. The recognition of the true nature of the lesion is important. The absence of any history of trauma and the asymptomatic nature of the lesion distinguish it from a traumatic fracture. More difficult, and more important, is the differentiation from a metastatic focus. The transverse fracture line, almost constant location of the lesion in the anterolateral arcs of the third to the fifth ribs, slow progression, and tendency to heal either by spontaneous union or eburnation of the ends of the fracture fragments, as opposed to the moth-eaten rarefaction or destruction seen in metastatic disease, aid in the differential diagnosis.

Radiation osteitis of the ribs associated with pathological fracture is a slow developing lesion which may appear at varying intervals following initial irradiation. The eleven year interval in the case reported is believed to be one of the longest recorded in the literature. Healing of such fractures may occur, but the process is very slow, as shown by the presence of only partial healing in one such fracture during a six year observation period.—*R. S. Bromer, M.D.*

Korossy, A. Ein Fall von Rippen-Echinokokkus. (A case of echinococcosis of the ribs.) *Radiol. clin.*, Jan., 1950, *19*, 13–17.

The author presents a rare case of echinococcosis of the ribs. Parasitic infestations of the bone are observed seldom in Hungary and therefore the diagnosis was missed. In retrospect, the author thinks that if the possibility of the occurrence is kept in mind, the lesion should be recognized.

The case was that of a woman, aged thirty-one, who in March, 1948, one month after contracting a cold, noticed a swelling of the left lower chest wall between the spinal column and scapula. Fluoroscopic examination of the chest made elsewhere in May, 1948, revealed an opacity in the same area which was interpreted as abscess of the lung. The author himself performed a roentgen examination of the chest in July, 1949, and made a diagnosis of tuberculosis of the rib. The patient was operated on and five echinococcus cysts were found in the posterior portion of the shafts of the left eighth and ninth ribs.

The following findings were noted on the roentgenogram of the chest which is reproduced: There was a marked destruction of the shafts of the left eighth and ninth ribs posteriorly. The mesial portion of the destroyed shafts showed a complete disappearance of the osseous structure, there being only a faint outline of the ribs present. The lateral portion, on the other hand, appeared slightly ballooned and definitely cystic. A similar process was observed in the transverse process of the eighth dorsal vertebra.

In re-evaluating these findings after the operation the author believes that they, together with the painless swelling at the site of the involvement, should direct the attention to echinococcus cysts rather than to tuberculosis of the ribs with cold abscess formation. A differential diagnosis from chondroma, giant cell tumor, Recklinghausen's osteitis fibrosa cystica, Hodgkin's disease, multiple myeloma and metastatic carcinoma should encounter no difficulty. The only other condition which may lead to serious error is hemangioma. Clinical findings, however, such as eosinophilia, positive complement fixation and the demonstration of the parasites by puncture biopsy, should make the diagnosis of echinococcosis certain.—*T. Leucutia, M.D.*

Falk, Wilhelm. Beitrag zur Pathogenese und Klinik akut entzündlicher Knochenerkrankungen im Kindesalter. (Contribution to the pathogenesis and clinical course of acute inflammatory bone diseases in childhood.) *Ann. paediat.*, July, 1949, *173*, 23–33.

This report deals with an unusual type of pronounced rarefying osteitis and heavy periostitis in a ten months old infant. The process affecting rather symmetrically the distal ulnae,

phalanges of fingers and toes, and several metacarpal and metatarsal bones was believed to be caused by circulatory changes following severe *exposure to cold*. The bone changes were preceded and accompanied by a well demarcated livid discoloration and swelling of the distal extremities. Roentgenologically the observed bone changes showed striking resemblance to those occurring in various types of bone infections. The presence of tuberculosis, syphilis, osteomyelitis, rickets and scurvy were excluded by proper clinical evaluation and laboratory tests.

Under symptomatic treatment a rapid regression of the observed bone changes was noted. The author refers to a similar case previously recorded in the literature.—*H. S. Weens, M.D.*

Mussey, Robert D., and Henderson, Melvin S. Osteochondromatosis. *J. Bone & Joint Surg.*, July 1949, *31A*, 619–627.

In this paper the clinical records of all patients who had undergone operation at the Mayo Clinic from 1910 through 1945 for loose bodies in the joints or in adjacent bursae were reviewed. All cases were included in which four or more loose bodies had been removed, unless these bodies were apparently secondary to trauma. One hundred and four patients were included in the study.

Osteochondromatosis is a benign condition, probably neoplastic, involving the synovial membrane of joints, bursae and tendon sheaths, in which cartilage develops by metaplasia of the connective tissue cells of the membrane.

The authors believe that repeated slight traumas may well be an etiological factor, although infection probably is not. There may be an individual predisposition toward neoplasia. The symptoms, weakness, aching and progressive limitation of motion, are vague and chronic in type and they vary according to the anatomical structure of the joint involved. Later, catching or locking may occur, although it is usually of a transitory nature, followed by slight effusion, pain and stiffness. Spontaneous disappearance of loose bodies may occur. In regard to the differential diagnosis, rice bodies associated with chronic infections, such as tuberculosis, are differentiated with ease microscopically and with relative ease on the basis of history and findings. When there are few bodies, the differential diagnosis may become difficult, because loose bodies may be produced in osteoarthritis, in osteochondritis dissecans, and occasionally after trauma. The condition also must be differentiated from a torn meniscus when the bodies are not radiopaque.

The authors conclude that all accessible loose or pedunculated bodies should be removed surgically, because of the discomfort to the patient and the danger of secondary osteoarthritis which is a frequent complication. If the process in the knee joint appears active in the synovial membrane at the time of operation, synovectomy should be done. Unsatisfactory postoperative results are usually due to osteoarthritic changes in joint surface contours, and not to loose bodies. Negative findings on microscopic examination of the synovial membrane do not necessarily negate a diagnosis of osteochondromatosis, for the process may have completed its cycle and the membrane resumed its normal appearance.—*R. S. Bromer, M.D.*

Valls, J., Ottolenghi, C. E., and Schajowicz, F. Condroblastoma epifisario. (Epiphyseal chondroblastoma.) *Rev. ortop. y. traumatol.*, July-Oct., 1949, *19*, 17–46.

This is a report on 7 cases of chondroblastoma of the bone, 6 of which were localized in the epiphysis of long bones and 1 in the talus. The patients varied in age from thirteen to eighteen years; the authors insist that reported cases of this condition in patients over thirty years of age are probably not true cases of chondroblastoma. Every one of these cases followed a benign course. The tumor is considered to be distinct from a chondroma and also from a giant cell tumor. The authors call these lesions epiphyseal chondroblastomas to call attention to one of its main features, namely, its usual location.—*J. A. del Regato, M.D.*

Ribbing, S. Hereditary, multiple, diaphyseal sclerosis. *Acta radiol*, June 30, 1949, *31*, 522–536.

As opposed to the types of osteosclerosis associated with infections, fractures, diseases of the blood or abnormal stress, there is a group of sclerosing osseous lesions, the etiology of which is less clearly understood. This group comprises marble bone disease, melorheostosis, osteopoikiia, the spotted epiphyses, and rarest of all judging by the literature, Englemann's disease. Somewhat similar to the latter condition are the cases of multiple diaphyseal

sclerosis observed by the author in 4 siblings.

Summary of the Cases. Four of 6 siblings showed diaphyseal osteosclerosis and hyperostosis in one or more up to four of the long bones. There was a certain tendency towards symmetrical involvement but this was not regularly present. Pain, presumably corresponding to the time of onset of the disease, began about puberty. The changes advanced very slowly for a number of years and subsequently seemed to become stationary. There were no signs of systemic involvement. Chronic anemia, enlargement of the spleen and endocrine stigmata were absent.

Each of the 4 patients presented a normal body appearance, exhibited normal sexual development and showed average intelligence. No fever or indication of systemic disease accompanied the onset in any case. Diaphyseal sclerosis may develop insidiously so that the patient fails to notice it. On the other hand, there may be boring deep pain in the leg (especially below the knee). This may persist for as long as two years.—*Mary Frances Vastine, M.D.*

Wells, Paul O. Fibrous dysplasia of bone (monostotic). *Radiology*, May, 1949, *52*, 642–654.

The author reports 9 cases of this condition proved by biopsy and mentions 13 additional unverified cases. He believes that the diagnosis of this condition can be arrived at with relative ease on the basis of roentgen appearance in most instances, although these features are not always specific or pathognomonic.

The lesions of fibrous dysplasia have been reported as occurring in practically every bone of the skeleton, though the ribs and the long bones of the extremities are most frequently affected. The bones of the lower extremity are a particularly favorite site.

Characteristically there is a localized, well demarcated area of decreased density within a bone. When a long bone, this is limited to the diaphysis or the metaphyseal side of the epiphyseal line. The location is eccentric, with involvement of the endosteal surface of the cortex at some point. Usually there is homogeneous increased density within the lesion, giving it a "smudged" or "ground glass" appearance. The bone is usually slightly to moderately expanded but if there is extensive involvement there may be severe deformity. There is no periosteal reaction (except following a pathological fracture), penetration of the cortex or soft tissue invasion. Especially in the small lesions there is a zone of increased density surrounding the area of involvement. The uninvolved bone is of normal density. Lesions tend to extend slowly in childhood and to remain stationary in adults. Pathological fractures are not infrequent.

The age incidence is generally childhood or early adult life. There may be elevation of the alkaline phosphatase but otherwise the blood chemistry is normal. There are no signs of inflammation or soft tissue tumors in the overlying skin and subcutaneous tissues.

Various other bone lesions must be considered in the differential diagnosis. In non-osteogenic fibroma there is absence of the "smudged" appearance. The same applies to bone cysts where is also absence of bone condensation. Enchondromas occur most commonly in the small bones of the hands and feet and they tend to be centrally located in the medulla. Giant cell tumors are usually located in the epiphysis of a long bone and the lesion proper contains no calcification. In eosinophilic granuloma, Letterer-Siewe's and Hand-Schüller-Christian disease there is no intrinsic increased density, and the bones of the leg, which are the common sites of fibrous dysplasia, are usually spared. Neurofibromatosis develops osseous defects by erosion of the fibrous nodule from the periosteal surface into or through the cortex. There is absence of calcification within the lesion. Chronic bone abscess shows absence of trabeculation within the lesion, little or no expansion of the cortex and a zone of sclerosis around its margins.

Pathologic examination of all 9 verified cases showed the gross and microscopic changes described by Lichtenstein and Jaffe and by Schlumberger. Some lesions contained tiny fluid-filled cysts but in only one was there a true cyst of any considerable size.

The exact nature of the disorder underlying fibrous dysplasia remains unknown. It is improbable that trauma is a fundamental factor and it is well established that there is no relationship between it and hyperparathyroidism. The prognosis is good in that the condition tends to be self limited although a few cases have been reported with subsequent development of sarcoma. Treatment is indicated in those cases which are symptomatic or where pathological fracture is probable or has occurred

repeatedly. Excision or curettage and bone graft are usually adequate in the adult. Irradiation is generally considered to be ineffective.

The illustrations are excellent and consist of eighteen roentgenograms and one photomicrograph.—*Arthur E. Childe, M.D.*

Ponseti, Ignacio V., and Friedman, Barry. Evolution of metaphyseal fibrous defects. *J. Bone & Joint Surg.*, July, 1949, 31A, 582–585.

Localized defects in the metaphyses of long bones have been described as "cyst-like" areas, "non-osteogenic fibroma," "metaphyseal fibrous defects" and "monostotic fibrous dysplasia." The authors had the opportunity of following by roentgenograms, for a period of thirteen years, the evolution of such defects in the metaphysis of the upper extremity of the humerus. The case is reported in detail. Biopsy of the lesions was not done. However, the roentgenographic features were identical with those found in many metaphyseal defects seen by them in their hospital experience which, at biopsy, were found to be filled with fibrous tissue. In some instances, this fibrous tissue contained foam cells, small giant cells, and new bone formation.

In their patient, three metaphyseal defects all appeared in the same area of the humerus. Each defect followed a similar course, and, as their borders became sclerotic, they migrated toward the diaphysis, finally disappearing in a period of from one to seven and one-half years. The natural course and the fact they all originated from the same area would appear to be strong arguments against Jaffe and Lichtenstein's belief that they represent benign tumors formed from marrow connective tissue.—*R. S. Bromer, M.D.*

Theilkäs, Ernst. Albers-Schönberg'sche Marmorknochenkrankheit mit eigenartiger Veränderung des Brustbeins bei Vater und Sohn. (Albers-Schönberg marble bone disease with peculiar change of the sternum in father and son.) *Radiol. clin.*, Jan., 1950, *19*, 1–6.

The author describes a peculiar manifestation of Albers-Schönberg disease which was discovered in a twenty-one year old, somewhat asthenic student during the course of a serial roentgen study of a deformed sternum. The tomograms surprisingly revealed five rather regular punched-out areas of the sternum, two in the manubrium, two in the corpus and one in the xyphoid process. These areas showed fine spongiosa structure thus representing medullary cavities. They were surrounded by concentric rings of compact bone about 1 cm. thick.

Subsequent roentgen examination of the entire skeleton revealed a typical Albers-Schönberg disease involving the spinal column, pelvis, femora, tibiae, humeri, and clavicles. The bones of the skull, hands, and feet were unaffected, except that there was a brachymesophalangia and a clinodactylia.

On investigation of the familial background it was found that the patient's father who was fifty-one years old was also afflicted with Albers-Schönberg disease showing identical localizations in the skeleton and having the same type of sternal deformity. The comparative roentgenograms in the father and son are reproduced. Furthermore, the anomalies of the hands were present in the patient's late paternal grandfather but it is not known whether he also had Albers-Schönberg disease.

In concluding, the author states that although sclerosing changes of the sternum have been described before in Albers-Schönberg disease, this is the first case of a punched-out sternum or "Lochsternum." The case also serves as additional proof of the fact that Albers-Schönberg disease is hereditary in nature.—*T. Leucutia, M.D.*

Key, J. A. Calcium deposits in the vicinity of the shoulder and of other joints. *Ann. Surg.*, June, 1949, *129*, 737–755.

The author offers a very well handled review of the general subject of calcium deposits in the shoulder cuff and also mentions similar findings in the vicinity of other joints. His discussions of incidence, etiology, pathology and clinical course are excellent and accompanied by interesting photomicrographs of actual calcium deposits and inflammatory processes. The author favors operative removal of the calcium deposits but outlines other forms of therapy also in current use. The paper is followed by an open discussion by the following authorities: Dickson, Gilcrest, Bennett and Copeland. In the discussion, several views are presented from different sections of the country.—*C. L. Hinkel, M.D.*

Cocchi, Umberto. Zur Frage der Epiphysenossifikation des Humeruskopfes. Das Tuberculum minus. (On the question of the epiphys-

eal ossification of the humeral head. The lesser tuberosity.) *Radiol. clin.*, Jan., 1950, *19*, 18–23.

The author examined 43 normal children (23 male and 20 female between the ages of two and a third and nine years to determine the ossification of the lesser tuberosity of the humerus. It was established that the view of the old anatomists, according to which the lesser tuberosity has an ossification center of its own, is correct. The contrary opinion of the roentgenologists is considered as being due to faulty positioning. The three ossification centers of the head of the humerus are, according to the author, best visualized in the following position: the arm is rotated outward and abducted at a right angle, the central ray being directed into the axillary fossa with the roentgen tube parallel to the sagittal diameter of the thorax and inclined 10° caudalward.

An independent lesser tuberosity makes its appearance between the ages of three and four years and forms a synostosis with the two other bones of the head of the humerus between the ages of six and eight years.—*T. Leucutia, M.D.*

Rounds, Roy C. Isolated fracture of the coracoid process. *J. Bone & Joint Surg.*, July, 1949, *31A*, 662–663.

A case of isolated simple fracture of the coracoid process is reported because of the rarity of such an occurrence. In this case, it was believed that the fracture could not have been due to direct trauma, but was the result of indirect forces acting on the coracoid process. It was produced either by the force of sudden violent contraction of one or more of the three muscles attached to the process against a fixed scapula; or by sudden motion of the scapula away from these muscles, while they were in a contracted state.—*R. S. Bromer, M.D.*

Smith, Frederick M. Medial epicondyle injuries. *J. A. M. A.*, Feb. 11, 1950, *142*, 396–402.

This paper deals with an analysis of 143 cases of patients with medial epicondyle injuries who were treated in the Presbyterian Hospital, New York City, during a fifteen year period. Separation of this epiphysis is an injury of childhood or adolescence. Its occurrence is frequent. General consensus is that this is an injury of serious magnitude, but the author believes that many of these injuries are trivial. Late complications and poor functional results often occur because of overtreatment and too much conservatism. Certain injuries to the medial epicondyle, such as complete avulsion from the humerus with displacement into the elbow joint or traumatization of the ulnar nerve at the time of the original injury are serious injuries from their inception.

The medial epicondyle gives rise to the site of origin of the flexor-pronator group of muscles. It is really not an epiphysis but an apophysis. It projects from the bone as a muscle and ligamentous attachment only. The mechansim by which it is separated in all probability is similar to that which causes a posterior dislocation of the radius and ulna on the humerus, namely, a fall on the hand with the elbow in extension.

There are five different types of injury to the medial epicondyle: (1) Epiphyseal trauma without separation. There will be a normal roentgenogram of the injured elbow but the pain is usually increased by attempts of the patient to pronate this forearm against resistance. No splint is necessary in the treatment of this condition, but the use of a sling is advisable to allow partial rest and relaxation of the flexor muscles of the wrist.

(2) Slight separation of the epicondyle. Pain, tenderness and swelling are present. Roentgen examination will confirm the diagnosis and will rule out or disclose additional bony injuries. Treatment consists of complete rest with the arm and forearm in a posterior molded plaster of paris splint and sling for four or five days, with the elbow flexed at a slight angle and the forearm in mid rotation.

(3) Definite separation of the epicondyle with or without dislocation at the elbow joint. Pain, tenderness, swelling and, in late cases, ecchymosis are found. Anteroposterior and lateral roentgenograms will show both the separation of the epicondyle from the diaphysis and the amount and position of the displacement. Reduction of the epicondyle is rarely possible by closed manipulation, and maintenance of reduction by external means is practically impossible. It is only when the ulnar nerve is affected or the epiphysis is displaced into the elbow joint that the displacement is important. The displaced epiphysis will become healed to the medial collateral ligament of the elbow joint by fibrous union and its displacement by as much as 2 cm. distad should cause no appre-

ciable weakness in the flexor-pronator group of muscles. Immobilization in a posterior molded splint for one week followed by the use of a sling, active exercises and mild active use should be sufficient treatment.

(4) Definite separation of the epicondyle with displacement into the elbow joint. Roentgen examination is necessary to confirm displacement of the epicondyle. The most important part of the diagnosis aside from comparative roentgen examination of the uninjured as well as the injured elbow is that the physician be aware that such displacement into the joint can occur. Careful examination for ulnar nerve function is extremely important. Operative procedures are preferable to manipulation when the epicondyle is displaced into the elbow joint. Three cases have been cited of successful attempts at manipulation to remove the fragments from the joint but there seems to be considerable risk accompanying such a procedure.

(5) Fracture of the medial epicondyle in adults. This is an extremely rare injury and usually occurs in conjunction with other fractures into the elbow joint. The diagnosis and treatment will be similar to that of a fracture in an older child. Conservative treatment followed by early active motion should result in good function.

Certain combinations of pathologic conditions, elapsed time and treatment are detrimental to full functional recovery of the elbow joint following this type of injury. Such combinations are: an original joint dislocation, prolonged splinting after reduction, and such forms of physical therapy as massage and weight carrying. Likewise detrimental to functional recovery is open reduction performed at a late date. Complete splinting for this injury regardless of degree of displacement should not exceed one week to ten days. An elbow after one of these injuries is splinted in flexion for three to four weeks may take close to one year to regain maximum joint extension. The same applies to recovery of flexion if the elbow has been splinted in extension.

In analyzing this series of cases, the author found that almost half of the patients showed irregularity of the medial epicondyle on follow-up examination, but in none of these could any loss of function be directly attributed to this irregularity. As for lack of perfect reduction of the displaced epicondyle, leading to fibrous union, pain and disability, none of the patients had any late pain and none had or showed any actual late disability. Failure to reduce the epicondyle did not lead to any recognizable subjective or objective weakness in flexor muscle power of the wrist. Failure to obtain reduction of the epicondyle fragment did not lead to any late disturbance in the sensory or motor function of the ulnar nerve.—*S. G. Henderson, M.D.*

Simril, Wayne A., and Trotter, Mildred. An accessory bone and other bilateral skeletal anomalies of the elbow. *Radiology*, July, 1949, *53*, 97–100.

The authors have established through gross, microscopic and roentgenographic evidence that there can be a true bone in the cubital fossa of the elbow. In their case, this ossicle was not a sesamoid bone or the residue of a hypertrophic arthritis. In this case, the ossicle was bilateral. The name os cubiti anterius has been suggested.—*C. H. Warfield, M.D.*

Bergmann, Ernst W. Fractures of the ankylosed spine. *J. Bone & Joint Surg.*, July, 1949, *31A*, 669–671.

Four cases are reported of fracture of the vertebral column in cases of Marie-Strümpell disease. Very little has been written in the literature on this type of fracture. A fifth case was not included in the report as the patient died shortly after he was admitted to the hospital. Although Bergmann can draw no conclusions from this small number of cases, they do have much in common. They all occurred in middle-aged men with a long history of ankylosis of the spine, complete from the occiput to the pelvis. This completeness of bony fusion he regards as a pertinent factor in the mechanism of the fracture, as the absence of any spring action within the spine makes it impossible for the impact of a fall to be absorbed. Unlike a fracture of the compression type in the ordinary spine, the ankylosed spine breaks like a long bone transversely, as a result of a bending force. All fractures occurred through what had formerly been the interspace, rather than through the substance of the body itself. Most of them were at the level of the interspace between the fifth and sixth cervical vertebrae. The time necessary for bone consolidation was short, the underlying tendency toward ankylosis obviously being responsible. The amount of cord or root involvement was in no way related

to the degree of anatomical displacement seen in the roentgenogram.

The fracture, although a serious injury, may afford an opportunity to attempt a certain degree of correction of the flexed attitude of the head, in order to improve the range of vision.—*R. S. Bromer, M.D.*

Schneider, Richard. Acute traumatic posterior dislocation of an intervertebral disc with paralysis. *J. Bone & Joint Surg.*, July, 1949, *31A*, 566–570.

Schneider states that as the speed of automobile travel has increased and accidents at high velocities have become more common, a corresponding rise has been noted in the frequency of injuries to the spine and spinal cord. Much attention has always been given to fractures and fracture-dislocations of the spine, causing paralysis, because the diagnosis is quite obvious in the roentgenographic examination. However, little comment has been made made about acute traumatic displacement of an intervertebral disc in the causation of paraplegia. Perhaps this is due in part to the fact that the disc herniation is not apparent in the roentgenogram.

The author believes that acute cases, whether due to recoil of the disc or to complete extrusion with compression of the cord or cauda equina, are more frequent than is realized. He reports 3 such cases observed in the past three years. In the first case, acute extrusion of the nucleus pulposus occurred within the thoracic region, with rapid development of paraplegia. Each of the other 2 patients had acute herniation of a disc in the lumbar region, with compression of the cauda equina and immediate paralysis.

He offers a word of caution to those doing myelography on these patients. In order to prevent further damage to the injured cord, the patient should be anchored securely to a board on the roentgen tilt table, with a firm supporting yoke at the shoulders and adjustable ankle supports. This enables tilting of the patient into an almost vertical head-down position, without compression of the vertebral column or the spinal cord.

These cases should be regarded as surgical emergencies. If one relies merely upon a positive jugular compression test as an indication that operation should be performed, extruded discs may be missed. Evidence of a blockage of a column of pantopaque upon myelographic examination in those cases which, in spite of a negative Queckenstedt test, have a sensory level, should be regarded as an operative indication.—*R. S. Bromer, M.D.*

Leonard, Morton H. Low insertion of the hip nail. *J. Bone & Joint Surg.*, July, 1949, *31A*, 612–613.

Leonard states that one of the common causes for failure in internal fixation of fractures of the neck of the femur and of intertrochanteric fractures is that the metal cuts its way out of the head or neck. This is sometimes due to a marginal position of the nail or screw in the head, and particularly in intertrochanteric fractures to a low insertion of the nail.

Illustrations are shown to demonstrate how this occurs. There is a length-wise ridge of bone in the neck of the femur, in the roentgenographic shadow of which a badly placed nail or other device for internal fixation may give the deceptive appearance of being within the confines of the bone. In cross section, the neck of the femur has the shape of a teardrop. A nail inserted in the bulge of the teardrop is actually centrally placed and so appears in the anteroposterior roentgenogram. On the other hand, a nail inserted too low in the neck may lie in part outside the cortex, and yet give the roentgenographic appearance of being within the neck. Both roentgenographic projections must show the nails or screws to be centrally placed.—*R. S. Bromer, M.D.*

Markheim, Herbert R. Legg-Perthes disease and slipped epiphysis in the same patient. *J. Bone & Joint Surg.*, July, 1949, *31A*, 666–668.

In a review of a series of 50 cases of Legg-Perthes disease, 1 case was found in which the condition developed in one hip while, at a later date, the other hip showed slipping of the capital epiphysis. The patient was an eleven year old boy. Roentgenograms showed on the first admission evidence of Legg-Perthes disease in the left femoral capital epiphysis and the metaphysis. Two years and eight months later, roentgen examination showed the same condition in the left hip with a slipped epiphysis in the right. The patient also had a chronic glomerulonephritis.—*R. S. Bromer, M.D.*

Haythorn, Samuel R. Pathological changes found in material removed at operation in Legg-Calvé-Perthes disease. *J. Bone & Joint Surg.*, July, 1949, *31A*, 599–611.

The material on which this pathological

report is based was obtained by curettement of the head of the femur in 36 patients. Thirty-three were considered clinically, pathologically, and roentgenographically to be Legg-Calvé-Perthes disease. One proved to be early osteogenic sarcoma, 1 was an early osteomyelitis following injury, and 1 was complicated by bilateral dislocation of the hip. In addition, material curetted from the head of the femur in patients over twenty years of age was examined and was found to differ from that seen in the average case of Perthes' disease by the absence of endochondral osteogenesis.

Haythorn, in his conclusion, states that the changes in the head of the femur in Perthes' disease were constant within fairly narrow limits, and included aseptic necrosis or necrobiosis, evidence suggestive of crushing, concurrent degeneration and repair, partial ossification of displaced cartilaginous tissue, loss of polarity of chondrocytes, small cartilaginous cysts, and areas of fibrous cyst formation with giant cells in the walls, similar to those found in osteitis fibrosa cystica.

The pathological changes, he regards, as those of disturbed metabolism rather than of trauma or infection and suggests that each case should be studied for bone age and disturbances due to hormone and vitamin deficiencies. As no single deficiency seems to be present in all cases, each case should be studied individually.

Removal of the contents of the head should in itself be beneficial since it eliminates debris that may lead to the formation of cysts and giant cell reactions.

The interpretation of Legg-Calvé-Perthes disease, based on a study of the material presented in the paper, is (*a*) that the disease is primarily a prepuberal degenerative condition with aseptic necrosis of the epiphysis and the upper portion of the metaphysis of the femur, depending in part upon some deficiency; (*b*) that the head becomes weakened to the point where weight-bearing injuries lead to slight flattening; and (*c*) that the remainder of the changes result from frustrated attempts at healing, which are obstructed by the presence of degenerated and displaced bone constituents and further complicated by the continued injuries of weight bearing.—*R. S. Bromer, M.D.*

Jowett, A. E. Opaque arthrography of the knee joint. *Ann. Rheumatic Dis.*, June, 1949, *8*, 149–155.

"Pylumbrin" (Boots) and 35 per cent diodrast (Winthrop) were the two opaque media. They are heavier than synovial fluid, do not mix with it readily, and are absorbed rather rapidly ($3\frac{1}{2}$ to 4 hours).

No allergic after effects were noted. Occasionally, a small effusion occurred but never any ill effects beyond a week. Biopsies of synovial membrane in several cases at the time of subsequent arthrotomy showed no evidence of irritation.

After local anesthesia, 5 cc. of synovial fluid is aspirated and mixed with the opaque medium which is then reinjected after aspiration of further excess fluid. Usually about 9 cc. of medium is used. The knee is moved several times and then roentgenograms are taken. The patient is kept in bed two days.

Seventeen illustrations depicting normal and abnormal arthrograms are shown with accompanying descriptive explanations.—*R. Datzman, M.D.*

Bradford, Charles H., Adams, Ronald W., and Magill, H. Kelvin. Fractures of the tibial spines. *New England J. Med.*, July 28, 1949, *241*, 137–141.

Fractures of the tibial spines are not common, but are important to recognize clinically and roentgenologically. The authors present 5 cases, and review the literature. The fracture is usually not one of the tibial spine proper, but an avulsion of the attachment of the anterior cruciate ligament, freeing an osteochondral fragment just anterior to the tibial spine. Although the bone fragment may be torn off completely, more commonly it is only slightly displaced at its posterior margin, and tilted backward and upward with elevation of the anterior margin. Slight degrees of separation are occasionally quite difficult to identify on roentgen examination.

The fracture is produced by forcible displacement of the tibia forward in relation to the femur, or by abrupt inward rotation of the tibia on the knee. Rarely, the lateral tibial spine is fractured without avulsion when smashed by the lateral femoral condyle, this event usually occurring only with associated tibial condylar fracture. The clinical picture is that of "internal derangement of the knee," with a history of injury followed by swelling and locking of the knee. More precise diagnosis is ordinarily based on roentgenograms, but it is important to note that in the anteroposterior view, the displace-

ment and fracture line may scarcely be noticeable, and in the lateral view, the avulsed portion may be so lightly ossified as to be readily overlooked unless films are of good quality and carefully examined.

Fractures of the tibial spine are treated by a stove-pipe plaster cast, after correction of the upward displacement by simple extension of the leg, under anesthesia if necessary. Open operation is rarely necessary.—*Henry P. Brean, M.D.*

Heyman, Clarence H., and Herndon, Charles H. Congenital posterior angulation of the tibia. *J. Bone & Joint Surg.*, July, 1949, *31A*, 571–580.

Congenital anterior angulation or bowing of the tibia has attracted the interest of orthopedic surgeons for many years. Although the deformity is rare, many writers have considered it as related to congenital pseudarthrosis. Experienced orthopedic surgeons are aware of the likelihood of non-union following fracture or osteotomy to correct angulation. Congenital posterior bowing, on the other hand, has not been described adequately.

The authors add a third group of cases to the two usually described. Group I is the form usually referred to. In all these cases there is an anterior or forward angulation of the tibia, and pseudarthrosis eventually develops. Group II consists of congenital angulations of the tibia characterized by anterior bowing, associated with talipes equinus and, occasionally, other congenital anomalies. Spontaneous fracture with pseudarthrosis is not the rule as in Group I. There is also shortening of the calf muscles. Group III is the group of congenital angulations which the authors submit as a clinical entity, distinct from those of the other two groups. The cases are characterized by posterior angulation or backward and medial bowing at the junction of the middle and lower thirds of the diaphysis of the tibia. The fibula is similarly bowed. There is severe talipes calcaneus, tightness of the anterior muscles of the leg and weakness of the triceps surae. A dimple may be present over the apex of the angulation. The lower extremity is short, confined chiefly, if not entirely, to the leg and there is underdevelopment of the muscles of the leg. The only detectable abnormality of the structure of the bone is a thickening of the cortex on the concave side of the curve. The upper and lower epiphyses of the tibia are not impaired and there is no tendency to fracture. The prognosis is good with conservative treatment.

Various etiological factors in the causation of the deformity are discussed. In the treatment, authors believe, osteotomy should never be performed. Therapy consisted of massage and stretching of the soft tissues which hold the foot in calcaneus and fitting the patient with a toe-to-groin brace with a leather cuff capable of being tightened posteriorly at the site of angulation. A stop-joint was used at the ankle to prevent calcaneus.—*R. S. Bromer, M.D.*

Aguilar, Antonio, and Lund, Erik Arnoldo. Espolón del calcáneo. (Spur of the calcaneum.) *Semana méd.*, Feb. 16, 1950, *57*, 239–244.

During the last five years the authors observed 26 cases of spur formations of the calcaneum at Rawson Hospital in San Juan. This rather frequent occurrence prompted them to review the most important features which characterize the condition.

The spur arises from the internal tubercle of the calcaneum. Most frequently it assumes a conical shape with the tip pointing forward and downward; at other times it appears in the forms of a parrot-beak, stump, or spinous process. Its length varies from a few millimeters to 3 or more centimeters. In the majority of the cases it occurs bilaterally but it may also be unilateral, or it may start in one foot and affect the other foot later. Structurally, the spur is composed of osseous tissue with trabeculae passing into the body of the calcaneum.

The etiology is varied. The condition is usually observed in persons over forty years of age, but sex, occupation, nationality, and race are without influence. Trauma, and less frequently chronic infections, constitutional diseases, and degenerative changes constitute definite etiologic factors.

The most important symptom is a "painful heel" which eventually leads to difficulty in walking or standing, although the patient never becomes bedridden. Local examination reveals no visible deformity; on palpation, however, there is nearly always marked tenderness to pressure.

The roentgen examination helps to establish the diagnosis beyond doubt and is therefore recommended by the authors as a routine procedure in all cases with unexplained pain in one or both feet.

The treatment consists of orthopedic measures associated with short wave therapy and iontophoresis. The authors have no experience with deep roentgen therapy. In case of failure, the spur is removed surgically.—*T. Leucutia, M.D.*

Harris Robert I., and Beath, Thomas. The short first metatarsal; its incidence and clinical significance. *J. Bone & Joint Surg.*, July, 1949, *31A*, 553–565.

The importance of shortness of the first metatarsal as a cause of disability of the fore part of the foot and of the longitudinal arch has been widely discussed since 1935 when Dudley Morton first advanced this thesis. The authors state Morton's thesis explaining how the shortness of the first metatarsal causes disturbances in the transmission of weight and thrust forces through the fore part of the foot. The findings of a Canadian Army Foot Survey in respect to the short first metatarsal are of considerable interest and importance, the more so since they do not support Morton's hypothesis.

The findings of this Survey lead the authors to the conclusion that a short first metatarsal seldom, if ever, is the cause of foot disability. Soldiers undergo the strenuous activity of military training with no disability from short metatarsals and react in no way differently from those who have long metatarsals. On the other hand, callus under the heads of the central metatarsals occurs in 0.97 per cent of young men, and is the cause of appreciable disability. It is not specifically related to short metatarsals, in the vast majority of which this evidence of local pressure is not displayed. Also, it occurs almost as frequently in feet in which the first metatarsal is longer than the second. It probably is due to sharp concentration of pressure under a metatarsal head prominent for reasons entirely different from shortness of the first metatarsal.

Measureable shortness of the first metatarsal relative to the second does not necessarily mean that it cannot as readily reach the ground and that less weight will be transmitted through this bone. The obliquity of the metatarsals in relation to the ground means that all can share equally in weight bearing, provided the longer metatarsals are on a higher plane than the shorter. This normally will be the case if the metatarsal arch exists. It is then possible for the second and third metatarsals to extend farther forward than the first before reaching the ground, because they are at the apex of the metatarsal arch.

In any case, the efficient use of the foot to support the weight of the body and to propel it in walking and running is not entirely dependent upon perfection of structure even though this is of importance. In feet which are not perfect in their structure, compensatory mechanisms of considerable efficiency develop, which tend to offset the ill effects that might arise as the result from deviation from the standard structure. In the case of the first metatarsal segment, the flexor hallucis longus can provide the necessary supplement to function. After all, foot function is dynamic as well as static.—*R. S. Bromer, M.D.*

Carroll, David S. Mycetoma pedis. *Radiology*, July, 1949, *53*, 81–84.

A case of mycetoma pedis (Madura foot) in a colored male is reported. The isolated fungus was *Actinomyces nocardia*. The outstanding roentgen findings are cystic destruction of bone, with little surrounding bone reaction and irregular thinning of the shafts of the tarsals, metatarsals and phalanges. The joints are also invaded. A brief history of the disease is given and its clinical course is also considered.—*C. P. Truog, M.D.*

GENERAL

Wasson, W. Walter. What further contribution can radiology make to medicine? *J.A.M.A.*, May 14, 1949, *140*, 133–135.

Neither diagnostic or therapeutic radiology has reached its peak. Continued and further research work by large institutions, small groups and individual radiologists is necessary for continued advancement of the science of radiology.

Therapeutic equipment has progressed faster than the radiologists' understanding of malignancies and apparently the kilovoltage range of modern equipment is satisfactory.

The author mentions angiocardiography and the electron fluoroscope as recent contributions to the advancement of diagnostic roentgenology but emphasizes that roentgen life span studies may lead to discovery of very early changes of fatal chronic diseases in middle life.—*C. A. Stevenson, M.D.*

Scott, Edwin Paul, and Temple, W. J. Osteoma cutis. *Am. J. Dis. Child.*, June, 1949, *77*, 758–762.

Cases of osteoma cutis have been reported under various titles, such as osteosis cutis, osteomatosis cutis, miliary osteoma and disseminated congenital osteomas. Many of the lesions, according to some authors, are secondary ossifications and may have originated from injuries, inflammatory processes or tumors.

The case reported here is that of a boy, nine years old. According to his parents, he had a vesicular eruption in the right thigh at two months of age. The rash spread rapidly and formed hard, firm, non-tender lesions in the skin. Subsequently, there appeared similar lesions on the arms, fingers, abdomen and left leg. Roentgenograms revealed small areas of apparent calcification in the region of the right thigh and left ankle and hilar enlargement with heavy markings in each lung. A pneumoencephalogram showed no abnormalities. A biopsy of the lesion on the right thigh was done and the diagnosis was osteoma cutis. The course in the hospital was uneventful and treatment was only symptomatic.—*R. S. Bromer, M.D.*

Strong. J. A. Generalized myositis fibrosa. *Ann. Rheumatic Dis.*, June, 1949, *8*, 158–160.

The author considers this a definite clinical entity which is quite rare, there being probably only 13 cases previously reported.

The patient was a woman, aged fifty-four, who had noticed pain and increasing difficulty in walking for the preceding five years. She thought this difficulty was due to high arches and an orthopedic surgeon constructed suitable shoes which relieved her symptoms for a time.

Twelve months prior to the present admission she began to feel tired and noticed her fingers were "curling up" and her feet were worse. She remained afebrile and otherwise had good general health.

There was limited extension and flexion of both hands but the joints were free of organic involvement. The feet demonstrated marked equinus and cavus deformity. The muscles were firm to palpation and gave the impression of being in spasm. Roentgenograms showed only slight osteoarthritic changes in the cervical and lumbar spine. *There was no subcutaneous calcification* or joint involvement of the extremities.

Sedimentation rate was 15 mm. in the first hour (Westergren), leukocyte count, 7,000, with a relatively normal differential.

The onset is insidious and the course is chronic. There is stiffness of the arms, legs and back not accompanied by fever or pain. Generalized involvement may occur leaving the face free. The skin is normal during the course and this distinguishes it from dermatomyositis which it must be differentiated from in early stages.

Biopsy demonstrates degenerative, chronic inflammatory, and fibrotic changes. There is hyaline and vacuolar degeneration of the muscle fibers with granules and loss of striation. Round cell infiltrations occur and fibrous replacement is seen in advanced lesions.

The etiologic factor is unknown. The treatment is conservative and designed to give symptomatic relief of the joint stiffness.—*John Scott, M.D.*

Michaelis, L. S. Englemann's disease. *Proc. Roy. Soc. Med.*, London, April, 1949, *42*, 271–273.

An adult case (twenty-four year old female) of this rare disease is presented. Personal history revealed delicate health, but no serious diseases. Stood and walked at two years. As a child showed weakness, lordosis and knock-knees.

The presenting symptoms were inability to stand, walk, run or kneel for long, and occasional pain in hip, though not incapacitating.

Physical examination showed the patient to be under middle height, thin, pale, with small blue hands and feet and long thighs, mustache on upper lip, muscular development poor, slight lumbar lordosis with hair over lower lumbar spine, knock-knees and valgus ankles, all joint movements free, disturbed gait, no neurological signs, liver and spleen normal.

Roentgenography showed symetrical sclerosis of anterior parts of inner table of skull and base of middle and anterior fossa; and symetrical hyperostosis and sclerosis, elongation and bending of diaphyses of long bones.

No decisive changes in blood chemistry were noted. The etiology is unknown.

A short review of previously reported cases is given.—*D. R. Bernhardt, M.D.*